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Environmental Assessment of Regulatory Strategies for Confined Animal Feeding Operations in Idaho

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Over the past several months EPA, Region 10 has been considering alternative means of regulating wastewater discharges from Concentrated Animal Feeding Operations (CAFOs) in the State of Idaho under the Clean Water Act's (CWA) National Pollutant Discharge Elimination System (NPDES) permit program. Due to the fact that there are new source performance standards for CAFOs, under Section 306 of the CWA, EPA must comply with the requirements of the National Environmental Policy Act of 1969 (NEPA) as a part of its decision making process on the resulting NPDES permit.

This environmental assessment (EA) documents the environmental analyses which EPA has completed as a part of its NEPA environmental review and its development of a proposed NPDES general permit that would regulate CAFOs in Idaho.

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ENVIRONMENTAL ASSESSMENT OF REGULATORY STRATEGIES FOR CONFINED ANIMAL FEEDING OPERATIONS IN IDAHO

Prepared for:

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EXECUTIVE SUMMARY

Introduction

Over the past several months EPA, Region 10 has been considering alternative means of regulating wastewater discharges from Concentrated Animal Feeding Operations (CAFOs) in the State of Idaho under the Clean Water Act's (CWA) National Pollutant Discharge Elimination System (NPDES) permit program. Due to the fact that there are new source performance standards for CAFOs, under Section 306 of the CWA, EPA must comply with the requirements of the National Environmental Policy Act of 1969 (NEPA) as a part of its decision making process on the resulting NPDES permit.

This environmental assessment (EA) documents the environmental analyses which EPA has completed as a part of its NEPA environmental review and its development of a proposed NPDES general permit that would regulate CAFOs in Idaho. This executive summary briefly describes:

1. EPA's proposed action;
2. The water quality problems associated with the operation of CAFOs;
3. The alternatives considered in EPA's environmental and regulatory review;
4. The environmental consequences of the alternatives; and
5. The steps which the environmental assessment and its supporting studies suggest would be necessary to adequately control CAFO related water pollution.

EPA's Proposed Action

EPA is proposing to issue an NPDES general permit to regulate discharges from CAFOs in Idaho. A general permit is a permit which regulates wastewater discharges from a group or category of dischargers within a geographically defined area. General permits are normally appropriate where there are several dischargers in an area, with the same or similar wastewater discharge characteristics, that should be subjected to the same or similar effluent limitations and permit conditions. The permit would apply to:

1. New and existing operations which discharge wastewaters to navigable waters and which stable or confine and feed or maintain for a total of 45 days or more in any 12-month period, more than the

numbers of animals specified in any of the following categories:

a. 300 slaughter and/or feeder cattle,

b. 200 mature dairy cattle (whether milked or dry cows),

c. 750 swine, each weighing over 55 pounds,

d. 150 horses,

e. 3,000 sheep or lambs,

f. 16,500 turkeys,

g. 30,000 laying hens or broilers (if the facility has continuous overflow watering),

h. 9,000 laying hens or broilers (if the facility has a liquid manure handling system), or

i. 300 animal units (defined in the proposed permit at Part I.F.2).

The proposed permit would prohibit the discharge of process wastewater pollutants (principally animal wastes) from CAFOs to navigable waters unless rainfall events, either chronic or catastrophic, caused an overflow of these wastes from a properly designed holding (treatment) facility. A properly designed waste holding facility would need to be **designed, constructed, and operated** to contain:

1. All process generated wastewaters (and animal wastes);
2. The runoff from a 25-year, 24-hour rainfall event for the location of the CAFO; and
3. Three inches of runoff from winter precipitation accumulations.

In addition, the proposed permit would require the implementation of best management practices to insure that the animals are kept out of streams and that contaminated surface runoff and other pollutants generated on-site will not enter the waters of the United States or contaminate groundwater.

CAFO Related Water Quality Problems

Animal waste contains several pollutants which can affect water quality. The most common contaminants are suspended solids, organic (oxygen consuming) wastes, bacteria, and nutrients (nitrogen and phosphorus compounds). These pollutants can cause several types of water quality problems including:

- Organic materials decrease dissolved oxygen (DO) concentrations, which may adversely affect aquatic animal life. They decrease dissolved oxygen by consuming it (exerting what is called biochemical oxygen demand [BOD]) as they decompose. Chemical substances in the wastes may exert chemical oxygen demand (COD), which will also reduce DO concentrations.

- Settling of manure particles in streambeds changes the composition of the bottom and can destroy spawning areas.

- Suspended particles may kill aquatic organisms by suffocating them.

- Bacterial and viral concentrations may increase and consequently lead to the spread of disease.

- Nitrogen compounds may kill aquatic organisms through ammonia toxicity.

- Nitrogen and phosphorus compounds may cause eutrophication of streams and lakes by increasing aquatic plant growth, which can lead to reduced flows, decreased light penetration, and fish kills.

- Mobile nutrients, especially nitrates, may cause groundwater contamination.

The available data, including the results of an aerial survey conducted by EPA, indicates that several rivers in Idaho are adversely affected by discharges from CAFOs. The more seriously affected streams include:

- The Boise River from Caldwell to the mouth, the Payette River from B.C. Dam to the mouth, and the Snake River from Strike Dam to the Boise River: The majority of the larger (over 200 animals) CAFOs are located in these drainages. Many have no impoundments.

- Upper Snake River Basin: Deep Creek, Big Wood River, Little Wood River, Rock & Mud Creeks are all heavily affected by smaller feedlots (under 200 animals).

- Bear River Basin: The Bear and Cub Rivers and Mink and Work Creeks are heavily affected by smaller feedlots.
- Salmon River Basin: The Salmon River from Riggins to the river's mouth, Rapid River, Whitebird Creek, and Rock Creek are all affected by CAFOs.

Regulatory Alternatives Considered

The EA evaluates four basic alternatives:

1. No Action--Maintain the status quo-do not issue new permits or replace/renew expired permits. This would let current practices and the resulting water quality degradation continue.
2. Issue individual permits for all CAFOs requiring a permit.
3. Issue a General Permit (the proposed action).
4. Issue a General Permit that includes special provisions for CAFO's in sensitive areas.

Environmental Consequences

No Action:

No permits would be issued and present conditions would continue. Under these circumstances few waste facilities would be constructed and water quality could be expected to degrade further. These effects could be most pronounced in the Southwest, Upper Snake, and Bear Creek River basins.

Many of these areas support threatened, endangered, or priority fish species which could be adversely affected by further water quality degradation. The indirect problems associated with CAFO discharges including clogged irrigation water intakes, weed growth in canals, fish kills, and fly and odor problems could be expected to continue and, perhaps, increase in severity.

General Permit (proposed action):

The proposed general permit would require many CAFOs to install and maintain waste containment facilities. In addition, the permit would require that "solids, sludges, or other materials removed by these treatment facilities" be disposed of in a manner which prevents their entering waters of the U.S. or creating a health hazard.

These changes would result in a significant reduction in the frequency of CAFO waste discharges to Idaho streams. This should result in substantial improvements in the water quality of these streams with corresponding improvements in fish habitat. The magnitude of the actual improvements cannot be calculated with currently available data. Similarly, the indirect impacts identified in the No Action alternative would be reduced to a significant degree.

The proposed permit, and the changes it would require, would result in some impacts on the operators of CAFOs. Existing operators would be required to either install or expand their waste containment facilities and improve their operating practices in ways that would keep animal wastes out of the water. New operations would be required to take similar steps. These actions will increase the capital and operating costs incurred by CAFO operators. However, the analysis suggests that, on a per head basis, these cost increases should be relatively small.

Individual Permits:

Under this alternative permits would be written for individual CAFOs. The terms and conditions of these individual permits would be similar to the terms and conditions of the proposed general permit. This would be similar to the existing program, with similar results, unless EPA and the state devoted significantly more staff to the task of developing and issuing these individual permits. There would be a corresponding increase in the administrative burdens placed on CAFOs that were required to apply for individual permits.

General Permit with Special Provisions for Sensitive Areas:

Under this alternative a general permit with terms like that of the proposed alternative would be issued. However, the permit would identify sensitive streams or watersheds where additional steps would be necessary. In these watersheds all operations, **regardless of their size**, identified as causing water quality degradation would be required to apply for coverage under the general permit. Also, in these sensitive streams, EPA might require additional measures on the part of individual operators to reduce the water quality effects of their wastewater discharges.

Due to these additional measures in sensitive watersheds, this form of regulatory action would produce the largest water quality benefits. It could also result in larger cost increases for CAFOs on these sensitive streams. The magnitude of these potential increases has not been quantified.

Conclusions

The proposed general permit could result in substantial water quality improvements in Idaho's streams. It will certainly result in significant improvements over existing conditions and is likely to produce better water quality than individual permits due to its more efficient use of limited EPA and state administrative resources. The general permit would allow EPA to devote substantially greater resources to enforcement. Consistent and firm enforcement of this permit, as with any other permit, is essential to achieving the desired water quality results.

The Environmental Assessment and the corresponding water quality study make clear that a significant portion of the problem on sensitive streams derives from the discharges from CAFOs that are smaller than would be regulated under the proposed general permit. For these streams (a substantial portion of the state), those smaller sources must be regulated in order to solve the water quality problems.

As a first step to solve this problem, EPA and state personnel will be identifying smaller CAFOs, along sensitive streams, that are "significant contributors of pollution to waters of the United States." These CAFOs would be regulated under the proposed general permit (they would be required to apply for coverage) or under individual NPDES permits.

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Chapter 1

INTRODUCTION

History and Purpose of the Permit Program

The Clean Water Act (formerly the Federal Water Pollution Control Act, PL 92-500), and its amendments (PL 95-217), have as their objective "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Section 402 of the Act authorizes the Environmental Protection Agency (EPA) to issue permits to control discharge of pollutants, and Section 306 requires establishment of performance standards for feedlots. Effluent guidelines and standards for the feedlots point source category are given in 40 CFR 412 and Appendix B of the National Pollutant Discharge Elimination System (NPDES) regulations (40 CFR 122).

In the mid 1970s, more than 70 NPDES permits were issued for feedlots and dairies in Idaho. A few permits were later canceled or the operations exempted, but most permits remained valid until their expiration (between 1979 and 1982). The EPA is now planning to update the permit program and is considering the issuance of an NPDES General Permit to replace individual feedlot and dairy permits.

Under EPA regulations (40 CFR 122.28), EPA may issue a General Permit to a category of point sources within the same geographic area if the sources:

1. Are involved in the same or substantially similar operation;

2. Generate and discharge the same types of waste;

3. Require the same permit effluent limitations and/or operating conditions;

4. Require similar monitoring requirements; and, in the opinion of the Director of the NPDES program, are more appropriately controlled under a General Permit than an individual permit.

As with individual NPDES permits, violation of a General Permit condition constitutes a violation enforceable under Section 309 of the Clean Water Act.

In order for a General Permit to apply to new sources (i.e., sources established after February 14, 1974), the consequences of issuing a General Permit must be reviewed under the National Environmental Policy Act (NEPA). This report therefore assesses the impact of a permitting program on both the existing (pre-1974) and new (post-1974) sources.

Objective and Approach of the Permit Program

The overall objective of the feedlot and dairy permit program is to achieve compliance with the federal pollutant elimination goal of PL 92-500, as amended, through control of discharges from confined animal feeding operations. The permit program is implemented statewide, and the regulations allow for enforcement of different-sized operations, depending on their impact to state waters.

The EPA has established Effluent Guidelines and Standards for the feedlots point source category (Title 40, Part 412). As defined by Appendix B of the NPDES Regulations, these apply to large operations containing 1,000 or more slaughter steers and heifers; 700 or more mature dairy cattle; 2,500 swine; 500 horses; 10,000 sheep; 55,000 turkeys; 100,000 laying hens or broilers (with continuous flow water systems, or 30,000 with liquid manure handling systems); 5,000 ducks; or combined operations having 1,000 or more animal units. Under Appendix B of the NPDES Regulations, these numbers can be decreased to 300 slaughter cattle, 200 dairy cattle, 750 swine, 150 horses, 3,000 sheep or lambs, 16,500 turkeys, 30,000 or 9,000 laying hens (depending on the type of waste system), 1,500 ducks, or 300 animal units where either: 1) the pollutants are discharged into navigable waters through a man-made ditch, flushing system, or similar device; or 2) the pollutants are discharged directly into waters of the United States which originate outside of and pass over, across, or through the facility or otherwise come into direct contact with animals confined in the operation.

In addition, under Section 122.23, any operation can be designated a concentrated animal feeding operation on a case-by-case basis upon determining that it is a "significant contributor of pollution" to waters of the United States. Smaller operations may therefore be regulated by permit as well. This possibility is important in Idaho because dairies are extremely numerous, a large number have no waste facilities, and the majority contain fewer than 200 animals. In some areas, the cumulative effect of these small operations has resulted in severe water quality degradation.

Because of the large number of animal feeding operations and their varying geographical concentrations, smaller operations may require enforcement in some areas but not others. This assessment analyzes a variety of enforcement options available to EPA under the permit program.

Report Organization

Chapter 2 assesses the current status of confined animal feeding operations, describes the associated water quality impacts, and identifies sensitive areas in the state where additional protection or enforcement through the permit program may be desirable. Chapter 3 briefly discusses treatment options and economics for in-process and end-of-process technologies and identifies those most appropriate for use in sensitive areas. Chapter 4 analyzes alternative permitting approaches available to EPA and assesses their impact on the EPA, the farmer, and water quality. It also analyzes impacts of the new permit criteria.

The EPA has recently completed an aerial photographic analysis of confined animal feeding operations located along the Snake River drainages in southern Idaho from Caldwell to Idaho Falls (EPA 1984 a,b,c and 1985). An assessment of the feedlot and dairy industry identifying concentration areas and impacts, assessing use of Best Practicable Control Technology (BPT) or Best Available Technology (BAT), and analyzing the potential use of a General Permit has also been recently completed (Jones & Stokes Associates 1985). These studies have quantified the areas likely to be most affected by the permit program. Much of the information from these studies is used as background information for this report.

Chapter 2

AFFECTED ENVIRONMENT

Idaho has traditionally been an agriculturally-oriented state. The majority of the attitudes, economic conditions, and political forces revolve around and are integrated with agricultural interests and activities. It is important to understand the impact and relationship of factors on dairy and feedlot operators so that workable management strategies can be devised and effectively implemented. This section briefly describes the current status of feedlots and dairies and summarizes some of the more important factors influencing dairy and feedlot management and regulation in general.

Current Status of Confined Animal Feeding Operations

Historical Overview

Feedlots differ from dairies in their geographical areas of concentration, average size, and total numbers. The number of animals in a feedlot can greatly exceed those found in a dairy, but the U. S. Department of Agriculture (USDA) Statistical Reporting Service (SRS) (Hasslen pers. comm.) estimates there are nearly 15 times as many dairies (2,500) in the state as feedlots (175). In the southern portion of the state, most of the large feedlots are centered in the Boise-Caldwell vicinity. There are relatively few large feedlots in the other areas. In contrast, dairies are more numerous in the vicinity of Twin Falls and Blackfoot. Although they are of smaller size than feedlots (generally fewer than 200 animals), sheer numbers make dairies a prime concern in these areas.

Much of the growing concern over dairies is due to a change in both size and number of operations. The typical dairy of the past was a family operation, having perhaps 60-90 animals. It was operated for self sufficiency, and there was little impetus for expansion. Most operations were built near canals or waterways, which served both to provide water and remove wastes (Collings pers. comm.). The tradition of placing wastes into waterways goes back a long time and, until the 1960s, pushing manure into waterways was often an accepted disposal practice.

Today's dairies are larger, with most having 150-200 animals. These are commercial operations, and they tend to produce much greater waste volumes than the older operations (Collings pers. comm.). Unlike feedlots, the number of dairies has increased greatly over the last few years. The number of dairy cows in Idaho increased by 23 percent between 1978 and 1982, with the majority of growth occurring in the Magic Valley area (IDHW 1984a). Centered around Twin Falls and Wendell, Magic Valley spans the area from Rupert to Bliss, extending northward to Shoshone and southward to the Idaho border. It now contains over 40 percent of the state's dairy herd (IDHW 1984a).

Many of the new dairymen are Dutch farmers who have moved from California's Chino Valley. The chief attractions in Magic Valley appear to be cheaper land and feed costs and little environmental regulation (Collings, Renk pers. comm.). Other conditions also differ, however. A combination of frozen ground and melt water from accumulated snowfall result in large volumes of spring runoff, a situation not encountered in the drier freeze-free climate of the Chino Valley. If these climatic factors are not taken into account by the farmer when designing waste lagoons, or if it is not alleviated by more frequent pumping, discharges will occur. Failure to understand this difference in climatic conditions may be one of several reasons why waste systems fail.

Dairies are classified as grade A or grade B dairies. Grade A dairy products are suitable for direct human consumption in forms such as milk and cream. Grade B dairy products are used in processed foods, such as cheese and ice cream. There is substantial incentive for a dairy to achieve grade A status because milk prices are higher for grade A milk (presently approximately $12.50 vs. $13.88 per hundred pounds of milk) (Collings pers. comm.).

There tend to be fewer wastewater problems with grade A dairies because these dairies require a permit and are inspected by the Health Department. To obtain grade A status, a dairy is required to have adequate wastewater disposal facilities. Enforcement is still a problem, however, because "adequate" facilities are not defined and Idaho regulations provide no penalties for violations. The Pasteurized Milk Ordinance provides penalties for infractions, but dairies in Idaho do not operate under this ordinance (Collings pers. comm.). The degree to which a grade A dairy can be made to install environmentally sound wastewater facilities is thus somewhat limited.

Grade B dairies produce approximately 70 percent of the milk. Although they are perfunctorily inspected by the Department of Agriculture, they are very loosely regulated because they are not required to obtain permits. Consequently, it is very difficult for the Department to require anything. Most dairy waste problems tend to be associated with grade B dairies (Palmer, O'Rourke pers. comm.).

Unlike feedlots, dairies produce large amounts of process wastewater on a year-round basis in addition to generating precipitation-caused runoff from cowyards. Opinions concerning the relative importance of runoff and process waste discharge vary with the area and individual. Some state and local personnel feel the two discharges are of approximately equal importance. Others feel the process waste is far more important, and still others place greater emphasis on the runoff. At present, if a dairy does have waste containment facilities, they are often designed only for process waste. Runoff containment has, for the most part, been essentially ignored by both grade A and grade B dairies.

Canals have an important relationship to confined animal operations in many areas. This appears to be particularly true in the Magic Valley area, where over one million acres of farmland are irrigated by over 3,000 miles of canals and laterals (IDHW 1984a). In this area, canals, rather than streams of rivers receive the majority of identified discharges. The one clear-cut enforcement tool for dairy and feedlot discharges is related to canals. Idaho Code Section 18.4301 "Interference with Ditches, Canals, or Reservoirs" prohibits discharge of filth or other materials or obstruction to the free flow of water. The canal companies are generally reluctant to enforce this code section, however, because the dairymen are generally stockholders in the canal company (Hopson, Collings pers. comm.). Letters in the IDHW files indicate at least two canal companies have occasionally sent letters to violators, but there was little evidence of serious followup; the canal companies tend to look to IDHW or the Health Department for enforcement (Hopson, Renk, Collings pers. comm.).

Fish hatcheries may also come into conflict with waste discharges from dairies and feedlots, particularly in the Twin Falls vicinity. The Magic Valley area contains approximately 100 hatcheries and produces approximately 90 percent of the nation's commercial trout (IDHW 1984a). Most are raised in individual ponds using water from springs in the rocks or from streams and canals. Hatcheries are located primarily in Gooding County, with most near Hagerman and Buhl (O'Rourke, McMasters pers. comm.). The direct discharge of wastewater and corral runoff has caused fish kills. Although kills are relatively infrequent, they are costly, as hundred or thousands of fish may be affected. Dairy wastes may induce weed growth in canals. IDHW files record several fish kills caused by chemical spills which were possibly related to weed control, although the reasons for use of the chemicals were not given.

A number of other factors also contribute to both dairy and feedlot enforcement problems. Just as there is no well-defined state mechanism for ensuring proper design of a waste facility, similarly there is no state enforcement procedure for improperly designed facilities. IDHW can review plans but is not required to approve them, and animal waste regulations have not been able to pass the Legislature (McMasters pers. comm.). When systems are properly designed, often they are designed primarily to serve existing conditions rather than to meet requirements of a farmer's long-range goals. A system designed for an existing operation may therefore become undersized if the farm expands. There is no local mechanism for ensuring that farms that increase their animal density also provide a corresponding upgrade in facility size. A lack of regulation to prevent groundwater pollution and a high percentage of absentee landlords is also of concern.

All IDHW districts identified lack of maintenance as perhaps the greatest obstacle to protection of water quality where wastewater containment facilities already exist. Because climatic conditions restrict pumping of facilities during winter months, designing to allow sufficient storage volume for these periods is important. The maintenance aspect must also be emphasized because any facility will overflow if not pumped out occasionally. Operator ignorance is generally not the reason discharges occur. Many operators simply find pumping of lagoons an inconvenience. Water pollution fines are rare and, if levied under state legislation, fines are small and generally easier to accept than construction of additional facilities or increased maintenance (Allred pers. comm.). Some Soil Conservation Service (SCS) personnel who work state-wide believe that, in general, more awareness or concern exists in southern Idaho than in the northern panhandle. This may be due in part to the greater concentration of operations in the south and the resulting increased emphasis on feedlots and dairies by SCS and IDHW.

Size and Number of Operations

As discussed in Chapter 1, the regulations for confined animal feeding operations cover a number of animal raising categories including hog and poultry farms and similar activities. Because these are so few in number, this report concentrates on feedlots and dairies, which will make up the vast majority of operations under the General Permit.

The USDA SRS reports 175 beef feedlots and approximately 2,500 dairies operating in Idaho in 1983. Table 2-1 provides a breakdown of the feedlots and dairies by size. The SRS defines a feedlot as an operation having a holding area and animals on feed for slaughter. It bases the facility size estimates on capacity rather than actual number of animals. Operations tabulated are considered to be commercial operations.

It can be seen from the table that by far the largest number of feedlots are operations of fewer than 1,000 animals. The large number of small operations identified by aerial survey (EPA 1984 a,b,c and 1985) indicates that the number of feedlots within the SRS "fewer than 1,000" category is still an underestimate; it is probable that many of the smaller

Table 2-1. Number of Feedlots, Dairies, and Animals Reported for the State of Idaho (1983)

FEEDLOTS		DAIRIES		
# ANIMALS	NUMBER	# ANIMALS	NUMBER*	
<1,000	120	1-29	65%	[1,625]
1,000-1,999	16	30-49	11.8%	[295]
2,000-3,999	15	50-99	16%	[400]
4,000-7,999	11	>100	10.7%	[26]
>8,000	13			
TOTAL	175		102.5%	~2,500

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* Statistics available for dairies record categories as percent and estimate total number at approximately 2,500. Figures in brackets are estimated.

SOURCE: USDA Statistical Reporting Service (Hasslen pers. comm.)

operations in this category have been missed, particularly those in the fewer than 50 and 51-200 size ranges.

This assumption is supported by the fact that the SRS also reports a total of 890,000 beef cattle within the state during 1983. Using the SRS size class data, assuming each identified feedlot contained the largest possible number of animals for its size class (with those in the "more than 8,000" class counted as having 8,000), the total number of animals accounted for would be approximately 400,000 (only 21 percent of the total). To account for such a large number of animals, the 13 identified feedlots in the largest size class must either have many more than 8,000 animals, or there are a large number of smaller operations that have not been identified. It is most likely that many smaller operations have been omitted.

It is difficult to equate results of the aerial survey with the SRS information because size classes used by the two sources differ. As the larger operations are more visible, however, it is likely that the number of operations in the larger size classes is more accurate than the number for smaller size classes. The SRS identified a total of 55 feedlots having over 1,000 head. The aerial photo survey identified only 17 operations of this size. Either the remaining feedlots are outside of the survey area, are within the area but were missed by the survey, or were included in the survey under an incorrect size category. As the number of animals varies widely within a feedlot throughout the year, this last possibility is quite likely. The greatest discrepancy between survey and SRS data, as expected, falls in the smallest size class.

The SRS reports dairies somewhat differently than feedlots. The total number of dairies is estimated at approximately 2,500, and the number of operations within a class is given as a percentage rather than an actual number. As with feedlots, the majority of dairy operations are in the smallest size class. Using the percentage and estimated total number of dairies, over 1,600 dairies can be calculated as belonging in the 1-29 animal size class. These figures seem to correspond to the aerial photo information better than the feedlot figures.

The SRS reports 172,000 dairy cows within the state. Assuming each dairy contained the maximum number of animals for its size class (with those in the more than 100 class counted as having 100), the total number of animals accounted for would be approximately 96,000 or 56 percent. Again, this seems to indicate that either a large number of operations have been missed by the SRS or that many of the 26 dairies within the "more than 100" class have a much larger number of animals than 100. Regardless of the actual number, however, the large number of operations identified has implications for water quality as well as for the permit process.

The sheer number of smaller facilities identified (probably a large underestimate in both the aerial survey and the SRS data) indicates that any permit and enforcement procedure aimed solely at the larger operations will be of very limited value in overall water quality improvement. These small operations are so numerous they produce almost a nonpoint source effect, and contribute significantly to water quality degradation. Any program developed must address these smaller sources if significant water quality improvement is to be expected. The area of greatest feedlot and dairy concentration occurs along the Snake River and its tributaries. This is the area covered in detail by the EPA aerial surveys (Figure 2-1).

Previous permits were generally issued only to the larger operations. Most of the previously permitted operations were feedlots because dairies are generally much smaller and few contain over 200 animals. All but one of the previously permitted operations lie along the Snake River and its tributaries (Figure 2-1):37, 20, and 10 were located in the Caldwell, Twin Falls, and Blackfoot/Pocatello areas, respectively. Only one permitted operation was located elsewhere (Salmon area). At least 2,000 smaller operations probably occur along the Snake River drainage as well.

There are some regional differences in distribution of feedlots and dairies. Distribution is primarily due to climatic factors and soil differences which affect crop growing. The Caldwell area contains most of the large feedlots and a number of small dairies and feedlots. The Pocatello-Blackfoot area has approximately equal numbers of dairies and feedlots. Nearly all are fairly small. Twin Falls contains by far the greatest number of operations, and nearly all are small dairies. Magic Valley, near Twin Falls, is the only location where the number of operations appears to be increasing, primarily due to migration from California. Other areas have few, if any, new (post-1974) sources.

Tables A-1 through A-6 in Appendix A show previously permitted sources and sources identified by the aerial survey for the Caldwell, Twin Falls, and Blackfoot vicinities. They also provide information on size, receiving waters, location, number of animals, access, and impoundments. These three areas are summarized and contrasted in Table 2-2.

The EPA surveys along the Snake River Plain identified approximately 300 dairies and feedlots. While these surveys cannot speak for the whole state (or even for the entire Snake River drainage, as many sources were missed and small sources away from water were screened out), the survey contains a large enough sample to provide some relatively useful statistics.

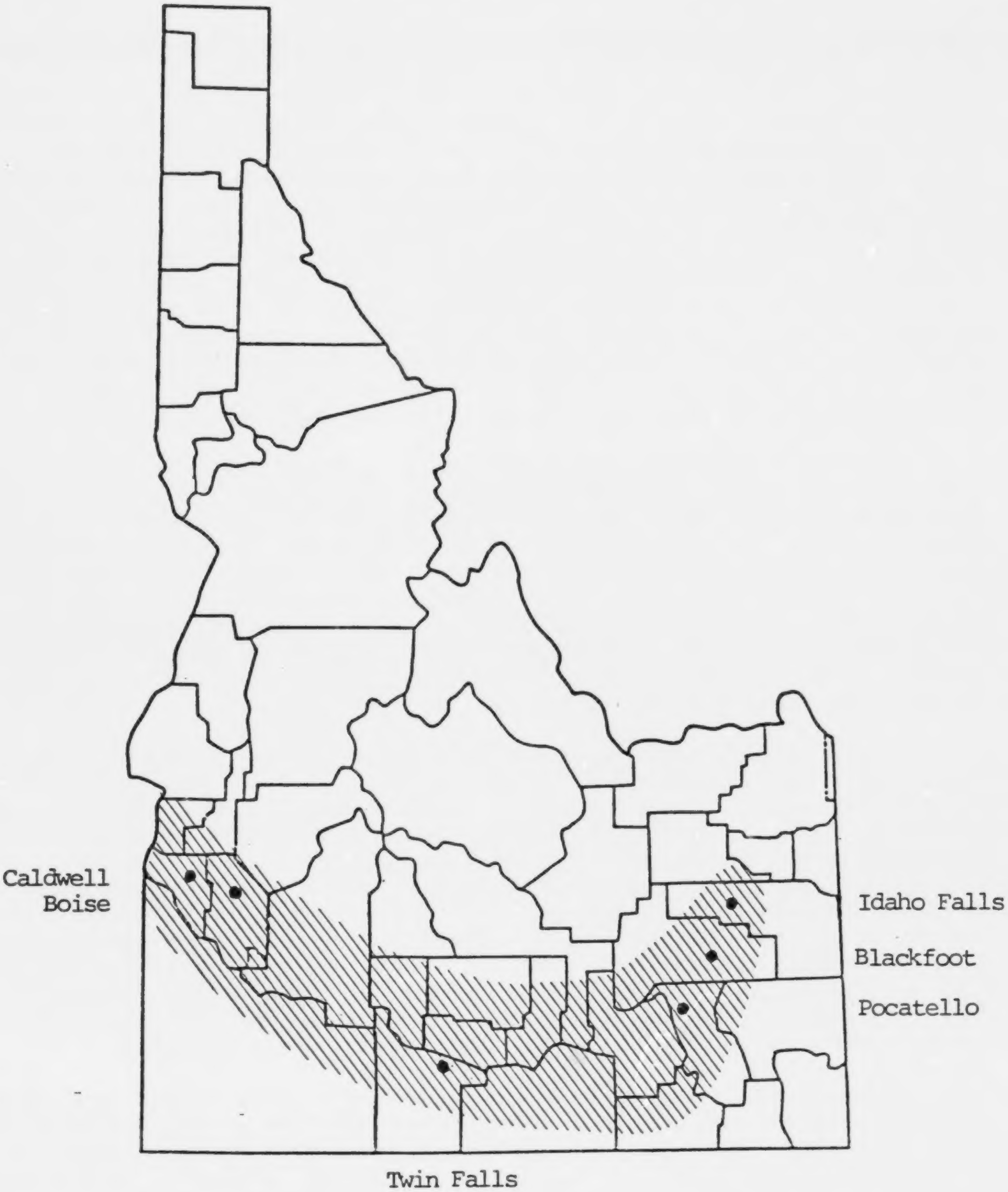
Caldwell
Boise
Idaho Falls
Blackfoot
Pocatello
Twin Falls

FIGURE 2-1. AREA COVERED BY THE EPA AERIAL SURVEY AND CONSIDERED TO BE THE GREATEST FEEDLOT CONCENTRATION AREA

Table 2-2. Comparison of Dairies and Feedlots Identified by Aerial Survey in Southern Idaho

	NUMBER AERIALLY SURVEYED	PERCENT WITHOUT IMPOUNDMENTS	PERCENT WITH DIRECT ANIMAL ACCESS TO WATER	AVERAGE SIZE OF OPERATION (AC)	AVERAGE SIZE OF IMPOUNDMENT (WHEN PRESENT)	MOST COMMON NUMBER OF ANIMALS
Caldwell[a]						
Dairies	5	40	40	41/12.5[a,c]	1.0 AC	200?
Feedlots	25	72	40	84/10.5[a,c]	3.6 AC	>1,000
Twin Falls						
Dairies	155	64	31	30/ 6.3[c]	1.4 AC	51-200
Feedlots	45	84	27	46/ 6.8[c]	2.3 AC	51-200
Blackfoot/Pocatello						
Dairies	33	91	48	2	0.6 AC	51-200
Feedlots	34	76	71	53/3.27[c]	2.6 AC[b]	51-200

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[a] Caldwell survey methodology differed from other areas by concentrating only on large operations. This should not be considered an average sample for the area.

[b] Excludes two operations where standing water is believed erroneously identified as impoundments.

[c] Averages for >20 AC and <20 AC operations.

SOURCE: Summarized from data in IDHW 1984a,b,c and 1985.

The average surveyed dairy covers approximately 6 acres and contains between 50 and 200 animals. The average feedlot covers approximately 24 acres, but this is somewhat misleading because feedlots tend to split into two groups: those having an average of 51-200 animals and those with more than 1,000 animals. They also tend to split into two size groupings: those averaging fewer than 10 acres in size and those averaging around 50 acres. Although dairies are normally smaller than feedlots, they are of greater concern as a group because of their large numbers and because they produce daily process waste as well as contaminated stormwater runoff. Dairies often have no impoundments of any kind; few of those having impoundments are designed to accommodate runoff. In contrast, facilities for feedlots are required primarily only for runoff containment.

A great number of both dairies and feedlots are located along streambanks and canals, and a large number allow animals direct access to the water. The number of dairies allowing access to water varies from approximately 31 percent in Twin Falls to 48 and 50 percent in Caldwell and Blackfoot/Pocatello, respectively. Feedlots show similar values, with percentages ranging from 27 percent in Twin Falls to 40 and 71 percent in Caldwell and Blackfoot/Pocatello, respectively. While other operations impact waterways only when runoff or facility overflow occurs, operations that allow cattle access to water will produce a year-round impact.

Existing Best Management Practices (BMP) Utilization and Effectiveness

A large number of existing manuals describe BMPs for both operation and maintenance of animal waste containment facilities. The degree to which these practices are used in southern Idaho varies a great deal, however, depending on individual farmer knowledge and concern, site-specific conditions, the degree of farmer interaction with SCS or other agencies, and the degree of detail and specificity of any waste facility plans which have been prepared. Conditions are expected to be the same for other areas of the state as well.

Contacting individual farmers to determine site-specific use of BMPs is beyond the scope of this project. It is possible, however, to provide a general overview of the types of practices which have been recommended and some indications as to their use by reviewing facility plans and talking to agency personnel. The aerial survey also provides some very limited information on BMP use in southern Idaho, primarily by indicating the presence or absence of fencing and impoundments. As BAT and BPT require containment of effluent and runoff, a lack of compliance can be assumed if no impoundments are present. The converse is not true, however; if impoundments are present, compliance with BPT or BAT cannot be assumed because the photos do not indicate the depth of the impoundments, and the containment volume can therefore not be calculated.

Very few facility plans were available; even for previously permitted operations, only one set of plans was found. A review of some of the more substantial plans for nonpermitted facilities, although they are not recent and probably not a representative sample, provides an indication of the variability of BMPs in use. Table 2-3 summarizes and contrasts the contents of seven of the more detailed dairy plans obtained from IDHW and SCS files. The plans were reviewed for three types of information that would relate to management practices: problem identification and background information, waste management system details, and waste utilization. If a plan contained any reference, however oblique or inadequate, to a particular topic, the topic was considered to be a part of the plan.

Because so few plans were available, the plans compared in Table 2-3 should not be considered representative of all dairies, but the comparison does bring out several interesting points. For one thing, the plans varied widely in content and detail. In problem assessment statements, only two of the seven plans mentioned anything that could indicate groundwater contamination was ever considered. Only three plans contained comments related to the possibility of offsite drainage, and only two contained reference (either beneficial or adverse) to potential impacts on surface water. Six plans mentioned soil types; five mentioned crops or acreage; and four made reference to air pollution, winds, or other odor-related factors.

In describing the waste management system, all but one plan mentioned a holding period (periods varied from 3-5 months); but only one (the most sophisticated) specified expected months of the holding period, and a fall date by which the pond should be empty. All plans mentioned the number of animals, but only two indicated rainfall runoff contribution and waste pit volumes, and only four included waste volume calculations.

In describing waste utilization practices, the application rate, location, timing, and nutrient content of the manure were rather consistently mentioned; application procedures and method of waste incorporation into the soil were mentioned in only three cases. In both the problem assessment and waste practices, greater emphasis appeared to be placed on air pollution and manure utilization than on water pollution control, as evidenced by less detail concerning manure containment at the dairy or after field application.

Table 2-3. Comparison of Dairy Waste Management Plans

	Problem Assessment Contents								Waste System Contents									Waste Utilization Contents					
	GROUNDWATER CONTAMINATION	SURFACEWATER CONTAMINATION	AIR POLLUTION	OFF-SITE DRAINAGE	SLOPES	SOILS	CROPS	FUTURE EXPANSION	WASTE TYPE	WASTE VOLUME	RUNOFF VOLUME	HOLDING TIME	EMPTYING PROCEDURE	SOLIDS HANDLING	ANIMAL CONTAINMENT PERIOD	NUMBER OF ANIMALS	IMPOUNDMENT VOLUME	APPLICATION RATE	APPLICATION TIME	APPLICATION LOCATION	APPLICATION PROCEDURE	METHOD OF INCORPORATION	NUTRIENT CONTENT
Plan 1 1980 (Pocatello Dairy)	-	-	x	x	x	x	x	x	x	-	-	4 mo.	3 times/ yr.	x	-	185	(Area- no depth)	-	As weather permits	x	Liquid spread.	Disc	-
Plan 2 1979 (Pocatello Dairy)	-	x	x	x	x	x	x	x	-	-	-	4 mo.	Pumped to sprinkler	x	Nov. - June	30	-	x	May - Sept.	x	Dil./ irrg.	Irrg.	x
Plan 3 1977 (Pocatello Dairy)	x	x	-	-	x	x	x	x	x	x	x	3 mo.	Pump to irrg. ditch	x	Winter	65	x	x	-	x	-	-	x
Plan 4 No date (Pocatello Dairy)	-	x	x	x	x	x	x	x	x	-	-	5 mo.	Pump to irrg. ditch	x	7-8 mo.	60	-	x	In favor. weather	x	-	-	x
Plan 5[a] 1980 (Pocatello Dairy)						x			-	x				x		160		x	Between cuttings	x	-	-	x
Plan 6 1980 (Pocatello Hogs)	-	-	x	-	-	-	x	-	x	x	-	4 mo.	Pump to honey wagon	-	-	72	-	x	-	x	-	-	x
Plan 7 1982 (Twin Falls Dairy)	x	x	-	-	x	x	-	-	x	x	x	3 mo. (Dec. 15 - Mar. 15)	-	x	-	150	37,500 ft^3	-	None after fall period	-	Slurry spread.	-	-

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x Topic covered or alluded to in some fashion.
- No indication topic was considered.
[a] Some plan pages missing.

The aerial photos indicate that a large percentage of dairies and feedlots have not constructed impoundments of any kind. Only 32 percent of the dairies (62 of the 193 surveyed) and 21 percent of the feedlots (22 of 104 surveyed) show evidence of impoundments. The degree of BAT implementation on feedlots having impoundments is unknown. No plans are available in the files, and the aerial survey indicates only surface area of the impoundments, not depth. Without the ability to calculate impoundment volume, use of BPT or BAT cannot be confirmed unless individual followup of these facilities is made. This is beyond the scope of this report. However, the presence of any impoundment, regardless of volume, indicates some degree of wastewater awareness; these farmers may be using various BMPs in other areas of feedlot management as well. In addition to lack of impoundments, approximately 38 percent of the operations in the aerial survey do not restrict animal access to water.

It cannot be assumed that management practices not described in a plan are not being used by the farmer. Conversely, describing practices in a plan does not necessarily ensure their implementation. But it can probably be assumed that if a practice is not specified in a plan, there is less chance of its implementation.

Existing Systems and Design Criteria

Many feedlots and dairies in Idaho currently experience periodic wastewater containment problems. These problems are intensified when the spring thaw follows a heavy winter snowfall, or when a warm spring rainfall rapidly melts the snowpack. Containment systems, when present, generally consist of a pond or pit at the lower end of a feedlot, allowing drainage water to enter by gravity flow. Many systems have been designed by the SCS as well as by IDHW personnel and private contractors. Although the SCS is generally considered a major source of expertise, the Twin Falls IDHW estimated that only 10 percent of the systems present in 1981 were SCS-designed (Renk 1981). This is likely to be true today as well. The SCS will not design for commercial operations, yet these operations, because of their size and number, constitute the bulk of the problem.

Waste containment facilities should be sized to contain animal wastes, process wastes, and runoff. Wastes from feedlot operations are similar to those from dairies, except that dairies have additional daily wastewater from the milking operation. Individual dairy waste volumes vary considerably depending on the operation and on whether they sell grade A or grade B milk; grade A dairies have more stringent cleanliness standards, which increase water use. Even within grade A or grade B dairies, washing procedures vary significantly. Daily waste volume will also vary depending on whether milking is done two or three times per day.

Files of previously permitted facilities that have received complaints were reviewed to determine the required design criteria and actual facility construction specifications. Effluent limitations information in the files indicated most older systems were required to design for a 10-year, 24-hour storm, although some less stringent exceptions were noted.

With one exception, the files contained no design criteria for any of the permitted facilities. It was therefore not possible to determine actual pond design volumes or dimensions short of conducting actual site visits, a task that is outside the scope of this project. The aerial survey indicates that although the previous permits required containment facilities, impoundments were never constructed. As mentioned previously, only 45 percent of the permitted facilities and only 28 percent of the total operations surveyed had impoundments of any type. Where impoundments do exist, their adequacy in many cases is questionable. Other unpermitted facilities were never required to have impoundments, although some do, particularly if they are dairies, because of the daily waste volume generated. It is unlikely that many of these sufficiently address rainfall runoff containment.

Two major factors related to containment functioning and/or enforcement were noted. First, the regulations allow for discharges in "chronic" and "catastrophic" conditions. As the regulations do not define these conditions, instituting legal enforcement measures against discharging facilities becomes difficult. These conditions have been interpreted differently by different people and in different areas, and the lack of a clear-cut definition provides a loophole for many dischargers. For example, EPA correspondence in compliance files for the Idaho Feedlot (Eagle) states that the "Idaho Feedlot Company considers snow and ice to qualify as a catastrophic event." As these conditions are commonplace in Idaho, Idaho Feedlot Company's assumption seems inadequate to meet the intent of the regulations.

The assumptions made in calculating the percent of runoff are a second factor related to impoundment effectiveness. A number of factors including slope, soil characteristics, infiltration, and other characteristics are normally used in determining expected runoff. In the past, design calculations for runoff have sometimes assumed a nearly 50 percent infiltration. In the Boise area, for example, design for a 2-inch rainfall has often assumed an infiltration of approximately 50 percent. This is unrealistic, since much of the precipitation falls in winter when the ground is frozen, and normal runoff values are not always appropriate. When considering the sealing and compaction that also occur in feedlots, it should be assumed that little infiltration is possible during winter. Using an infiltration rate that does not take these factors into account will result in an inadequately-sized facility.

Based on plan review and discussions with IDHW engineers, SCS personnel, and others, existing systems appear to be adequately designed for animal wastes but are often overloaded due to rainfall/snowmelt runoff or excess solids accumulation in the pond. As discussed previously, containment areas often cannot be pumped out in winter, and waste must be contained until fields or other disposal mechanisms are available to accept it. Cumulative rainfall of several days or weeks often routinely exceeds the volume expected from a single 25-year, 24-hour storm event. As a result, a 25-year, 24-hour design volume is inadequate to prevent overflow of containment structures even when such a storm does not occur.

Water Quality Impacts

Potential Impacts From Confined Animal Feeding Operations

Wastes generated by individual feedlots and dairies vary depending on the type of operation, the extent to which wastes may include bedding, barn, stall, or milkroom waste and the degree to which these mix with runoff water. On a per capita basis, dairy cows also generate greater quantities of waste than beef cattle, although potential water quality impacts from all operations are similar (see Appendix B).

Animal waste contains a number of pollutants which can impact water quality. The most commonly recognized contaminants are suspended solids and organics, bacteria, and nutrients (nitrogen and phosphorus compounds). They have been observed to cause a number of water quality problems:

- Organic materials decrease dissolved oxygen (DO) concentration, which may impact aquatic fauna. They exert biochemical oxygen demand (BOD). Chemical substances may exert a chemical oxygen demand (COD), which will also reduce DO concentrations.

- Solids affect aesthetics by causing coloration, turbidity (opacity caused by suspended particles), and odor problems.

- Settling of manure particles in streambeds changes the substrate and destroys spawning areas.

- Suspended particles may kill aquatic organisms by suffocation.

- Bacterial/viral concentrations increase potential spread of disease and other public health concerns. Organisms such as Vibrio, Rotavirus, Salmonella, and others are spread through dairy waste discharges.

- Nitrogen compounds may kill aquatic organisms through ammonia toxicity.
- Nitrogen and phosphorus compounds may cause eutrophication of streams and lakes by increasing aquatic plant growth, which leads to reduced flow, decreased light penetration, and fish kills.
- Mobile nutrients, particularly nitrates, may cause groundwater contamination. High nitrates pose a health hazard to young babies, who are susceptible to methemoglobinemia.
- Discharge to irrigation canals clogs irrigation intake pipes and/or reduces the quality of water available to irrigators.
- Discharge to canals increases growth of moss and aquatic plants, decreasing flow efficiency and raising canal maintenance costs.

These general impacts have all been noted in the study area. Twin Falls IDHW compliance and enforcement files contain reports linking animal waste to human disease, fish kills, irrigation intake pipe blockage, nuisance weed growth in canals, and water quality degradation. Weed growth greatly increases canal operational costs, and it is also responsible for an additional secondary aquatic impact. Chemicals such as xylene and acrolein, used to control algal growth in canals, are also extremely toxic to fish. Inadvertent diversion of contaminated water into fish-bearing streams has resulted in a number of documented fish kills, particularly in the Twin Falls vicinity. These chemicals were possibly related to weed control, although the reason for the chemical use was not recorded.

Other nuisance and health impacts from dairies and feedlots include generation of odors, flies, and occasionally fugitive dust. Although these are normally of less ecologic importance, people appear more willing to complain about these impacts than water quality impacts, perhaps because they are more directly affected by them.

A number of poor management practices may also result in water quality degradation. Inadequate control of runoff from animal confinement areas, poor manure storage and handling practices, field application of manure at improper times or during wet weather, or seepage from storage areas to canals, ditches, or streams all contribute to the impact of manure on waterways. Properly constructed facilities and proper operation, maintenance, and management practices are necessary to maintain water quality.

Runoff from animal confinement areas and the overflow of impoundments which often accompanies increased runoff are the prime concern of the permit program. Tables 2-4 and 2-5 provide characteristics of cowyard runoff waste generally expected for dairy cows and beef cattle. Table 2-6 provides characteristics of waste generally expected from a cowyard and milking center. Actual runoff will vary depending on the on-site conditions, but these tables provide a general idea of the kinds and concentrations of pollutants expected from many Idaho operations.

Although there are few Idaho runoff studies, a number of researchers in other areas have reported runoff quality from cattle feedlots. "Average" concentrations of pollutants in direct runoff discharge and in water discharged from collection ponds are shown in Table 2-7. These measurements were made in Texas, but the author believes them to be representative of other areas as well. While both discharges are still high in solids, COD, and some other parameters, the increased quality from the discharge pond indicates the value of impoundment construction. Laboratory analyses of runoff from Idaho cattle operations show total coliform bacteria levels up to 1,300,000/100 ml BOD measurements of 650 mg/l, and turbidity up to 508 NTU (Jones and Stokes Associates 1985).

Runoff can be extremely concentrated and of high pollution potential. Pollutant concentrations are greatly affected by amount and duration of a runoff event. "First flush" runoff can be particularly high in pollutants. Table 2-8 indicates the change in pollutant levels in runoff over time.

The high BOD levels are one reason for fish kills, as they deplete the dissolved oxygen levels in the receiving water. The reaction of a stream to a slug of feedlot runoff passing a sampling point in the stream is shown in Table 2-9. The time for the stream to regain sufficient oxygen levels can be quite long, depending on a number of factors including waste breakdown and stream characteristics.

Because it may be considerable, the impact of animal access to waterways should not be overlooked when assessing impacts of confined animal operations on water quality. Streambank trampling greatly increases erosion and downstream sedimentation of spawning areas and other aquatic habitat. Animal access also allows direct placement of manure into the water. Unrestricted access allows animal impacts to become a year-round problem, unlike impoundment discharges, which occur primarily when excess precipitation or poor maintenance cause an overflow. Unlike an impoundment discharge, unrestricted animal access produces essentially a nonpoint source impact. It is important to understand and control this impact

Table 2-4. Waste Runoff from a Dairy Confinement Area[a]

PARAMETER	LB/HEAD/INCH RUNOFF			mg/l		
	MINIMUM	AVERAGE[b]	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM
Total (wet solids)	No data	1,040.0	No data	-	-	-
Moisture	No data	1,031.7	No data	No data	992,000	No data
Dry solids	No data	8.32	No data	No data	8,000	No data
Volatile solids	No data	3.95	No data	No data	4,000	No data
Suspended solids	No data	No data	No data	No data	No data	No data
pH	No data	No data	No data	No data	No data	No data
BOD_5	No data	1.56	No data	No data	1,500	No data
COD	No data	3.64	No data	No data	3,500	No data
Ash	No data	4.37	No data	No data	No data	No data
Total nitrogen	No data	0.16	No data	No data	150	No data
Ammonia nitrogen	No data	No data	No data	No data	No data	No data
Nitrate nitrogen	No data	No data	No data	No data	80	No data
Total phosphorus	No data	0.08	No data	No data	340	No data
Total potassium	No data	0.35	No data	No data	No data	No data
Magnesium	No data	No data	No data	No data	No data	No data
Sodium	No data	No data	No data	No data	No data	No data

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[a] Assumes 200 square feet confinement/head and average animal weight of 1,300 pounds.

[b] Estimated values.

SOURCE: EPA 1974.

Table 2-5. Waste Runoff from a Feedlot Confinement Area[a]

PARAMETER	LB/HEAD/INCH RUNOFF			mg/l		
	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM
Total (wet solids)	-	1,040.0	-	-	-	-
Moisture	1,024.4	1,031.7	1,034.4	985,000	992,000	994,000
Dry solids	6.24	8.32	15.0	6,000	8,000	15,000
Volatile solids	3.95	4.16	8.32	3,800	4,000	8,000
Suspended solids	1.04	2.6	5.20	1,000	2,500	5,000
pH	5.1	7.6	9.4			
BOD_5	1.04	1.56	6.23	1,000	1,500	5,000
COD	3.12	3.64	31.2	3,000	3,500	20,000
Ash	2.08	4.37	7.8	2,000	4,200	7,500
Total nitrogen	0.02	0.16	0.14	20	150	1,100
Ammonia nitrogen	0	0.06	0.52	0	60	500
Nitrate nitrogen	0	0.03	0.12	0	25	120
Total phosphorus	0.01	0.08	0.22	14	80	200

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[a] Assumes a moderately sloped dirt yard allowing 200 square feet confinement/head and average animal weight of 800 pounds.

SOURCE: EPA 1974.

Table 2-6. Waste Expected from a Dairy Cattle Yard and Milking Center[a]

PARAMETER	KG/HEAD/DAY (LB/HEAD/DAY)			mg/l		
	MINIMUM	AVERAGE[b]	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM
Total (wet solids)	No data	84.0	No data	-	-	-
Moisture	No data	83.2	No data	No data	990,500	No data
Dry solids	No data	0.8	No data	No data	9,530	No data
Volatile solids	No data	No data	No data	No data	No data	No data
Suspended solids	No data	0.22	No data	No data	2,620	No data
pH	No data	8.0	No data	No data	No data	No data
BOD_5	No data	0.38	No data	No data	4,530	No data
COD	No data	No data	No data	No data	No data	No data
Ash	No data	No data	No data	No data	No data	No data
Total nitrogen	No data	0.15	No data	No data	1,790	No data
Ammonia nitrogen	No data	0.05	No data	No data	596	No data
Nitrate nitrogen	No data	No data	No data	No data	No data	No data
Total phosphorus	No data	0.015	No data	No data	179	No data
Total potassium	No data	No data	No data	No data	No data	No data
Magnesium	No data	No data	No data	No data	No data	No data
Sodium	No data	No data	No data	No data	No data	No data

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[a] Assumes average dairy cow of 1,300 lbs and (presumably) a 200 square foot confinement area/head.

[b] Although the source does not so indicate, it is presumed that values for this table are estimates, as is the case with those of similar format within the same report.

SOURCE: EPA 1974.

Table 2-7. Average Concentrations of Selected Chemical Parameters Found In Direct Runoff from Feed Pens and in Discharge Water from Collection Ponds

	DIRECT RUNOFF	DISCHARGE WATER
Biochemical Oxygen Demand (mg/l)	2201	558
Chemical Oxygen Demand (mg/l)	7210	2313
Total Solids (mg/l)	11429	3172
Total Dissolved Solids (mg/l)	5526	1875
Organic Nitrogen (mg/l)	228	64
Total Phosphate (mg/l)	70	38
Ammonia (mg/l)	108	50

SOURCE: Duffer and Kreis 1971, *in* Shuyler et al. 1973

Table 2-8. Pollutant Concentrations in Runoff from a Concrete Lot During a Single Storm Event

TIME OF COLLECTION[a]	pH	BOD (mg/l)	COD (mg/l)	NO (mg/l)	NH_3-N (mg/l)	ORG-N (mg/l)	ALKY (mg/l)
11:35 p.m.	6.60	16,800	48,000	625	525	532	2,595
11:58 p.m.	6.80	5,120	20,451	975	526	315	1,955
12:25 a.m.	6.65	7,400	22,032	1,000	485	36	2,000
2:25 a.m.	6.80	9,950	23,316	900	543	285	1,865

[a] Precipitation beginning 11:00 p.m., August 24, 1969

SOURCE: Texas Tech University 1970 *in* Shuyler et al. 1973

Table 2-9. Reaction of a Stream[a] to a Slug of Feedlot Runoff Passing a Sampling Point during a Single Storm Event and Comparison to Dry Weather Values

	WATER QUALITY PARAMETERS (MG/L)				
TIME	DO	BOD_5	COD	Cl	NH_3
Avg. Dry Weather Values	8.4	2	29	11	0.06
13 hours	7.2	8	37	19	12.0
20 hours	0.8	90	283	50	5.3
26 hours	5.9	22	63	35	-
46 hours	6.8	5	40	31	0.44
69 hours	4.2	7	43	26	0.02
117 hours	6.2	3	22	25	0.08

---

[a] Fox Creek near Strong City, Kansas, November 1962

SOURCE: Smith and Miner 1964 *in*
Shuyler et al. 1973

through management practices stipulated, if possible, in conjunction with permit conditions.

Water quality degradation from animal confinement areas occurs to the greatest extent primarily in winter and spring. During these periods, there is increased precipitation while soils are either likely to be frozen or saturated. Both conditions decrease soil infiltration capacity. Greater runoff quantities are likely to be generated, but less than normal amounts of water can be retained on-site. If rains occur when snow is present, meltwater will further increase runoff volume. Under such conditions, runoff may even exceed rainfall volume.

Water Quality Trends

The IDHW has not sampled trend monitoring stations since September 1983, so more recent data is unavailable. Although IDHW generally acknowledges that agricultural sources are primarily responsible for water quality degradation in all three basins, it is difficult to correlate water quality changes within a river segment to feedlot or dairy impoundment discharges and runoff. Data concerning input from various other types of sources, particularly nonpoint source activities, are scarce; runoff or impoundment discharges are often brief events, and river sampling occurred only once a month (and probably during good weather, when possible). For example, a large number of feedlot runoff complaints were received on May 17, 1982; the monthly routine river monitoring scheduled on May 15 did not, of course, record any impact.

A number of individual discharges have been sampled and analyzed; quality of discharges leaving farms has thus been documented. But a lag time often exists before discharges impact a waterway. Many operations discharge first to a canal or creek; few actually discharge directly to a major river segment. In addition, in areas where flow is closely regulated, use for power generation, irrigation diversion, and agricultural return flows all help to mask actual changes in water quality.

IDHW evaluates water quality in a stream segment by use of a Water Quality Index that provides a combined evaluation of temperature, dissolved oxygen, pH, aesthetics, solids, radioactivity, fecal coliform bacteria, nutrients (trophic level), and organic and inorganic toxicity. Actual measured values for these 10 parameters are compared to water quality criteria, normalized, and summed to produce the index value. This index makes a relative quality comparison of individual stream segments possible. It also establishes various pollution standards against which individual river segments can be compared. The index values for 1983 are shown for all of the major river segments of the state in Figure 2-2. Because water quality sampling was discontinued in 1983, no current data are available, but there have likely been few large changes.

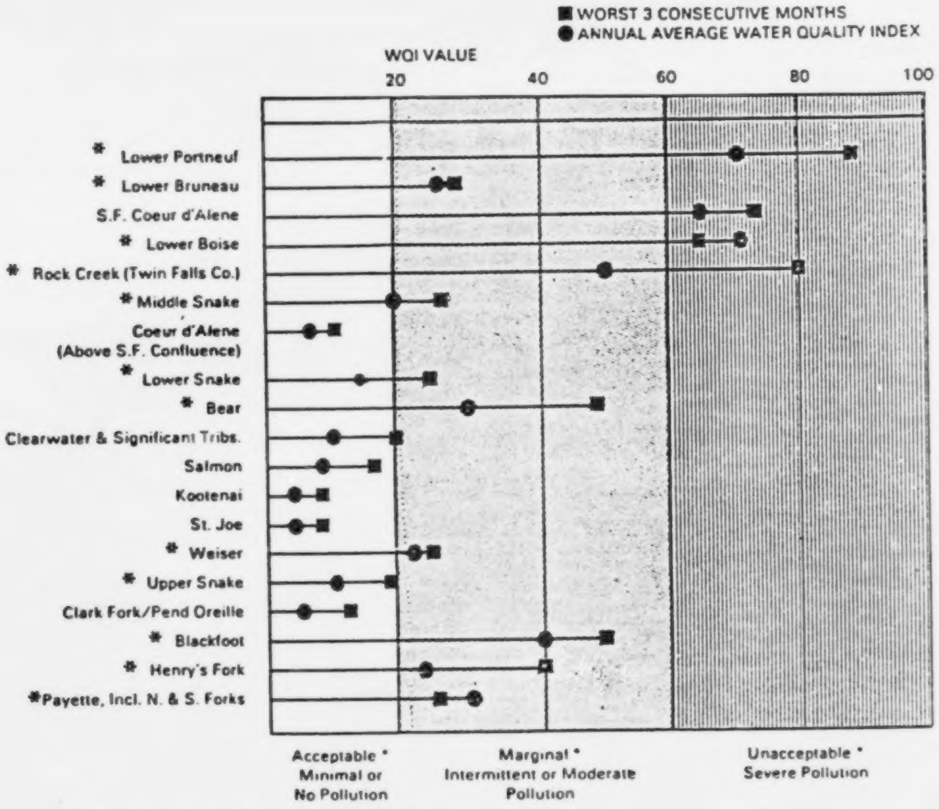
Water quality in the Snake River is very high as it enters the Upper Snake Basin; but as the river flows westward through the Southwest Basin, bacterial densities, nutrients, suspended solids, and turbidity increase. Elevated summer temperatures also become a problem (IDHW 1983a). Nearly all of the river segments within the Snake River area are classified as having marginal annual water quality (moderate or intermittent pollution), and a few, such as the Portneuf River, lower Boise River, and Rock Creek, fall into the unacceptable (severe pollution) range. High priority problem areas for 1983 and 1984 within the state river systems are shown in Figure 2-3. It should be noted that in 1983, the 1982 priority areas map was expanded to include three new high-priority areas located in the Bear River Basin, the Salmon River Basin, and the southern part of the Panhandle Basin (Figure 2-3A). One area, the Little Wood River, was removed from the high priority listing.

In 1984, priority areas were again expanded (Figure 2-3B) to include the Portneuf River, the Payette River, the Lower Wood River, and a number of new areas in the Salmon, Clearwater and Panhandle Basins. The 1984 priorities have been established based upon the realistic expectations of ability to remedy a poor water quality condition in a segment. They have also included undesignated waterbodies, particularly lakes and groundwaters. The priorities of 1984 thus do not necessarily reflect the segments in each basin having the poorest quality. Those considered so polluted that an extensive effort would be needed to produce noticeable results have received a lower priority.

Overall, a downward trend in quality appears to be indicated in both Idaho's lakes and rivers and streams over the past decade. The pie charts in Figure 2-4 indicate water quality and pollution sources for these waterbodies.

High Priority and Sensitive Stream Segments

Because a high number of small operations are often concentrated along certain river drainages, particularly in southern Idaho, little water quality improvement will occur if the permit is limited to only large operations. The great majority of dairies are in the 50-200 size range. In some areas, these are the largest operations found. Although these are below the general 200-animal guidelines set by the Appendix B regulations, their inclusion is authorized under Section 122.23 of the regulations if they are found to be significant contributors to pollution of waters of the United States, either by direct



* IN STUDY AREA BASINS

FIGURE 2-2. WATER QUALITY INDEX VALUES FOR IDAHO'S PRINCIPAL RIVERS (1983)

SOURCE: IDHW 1983A.

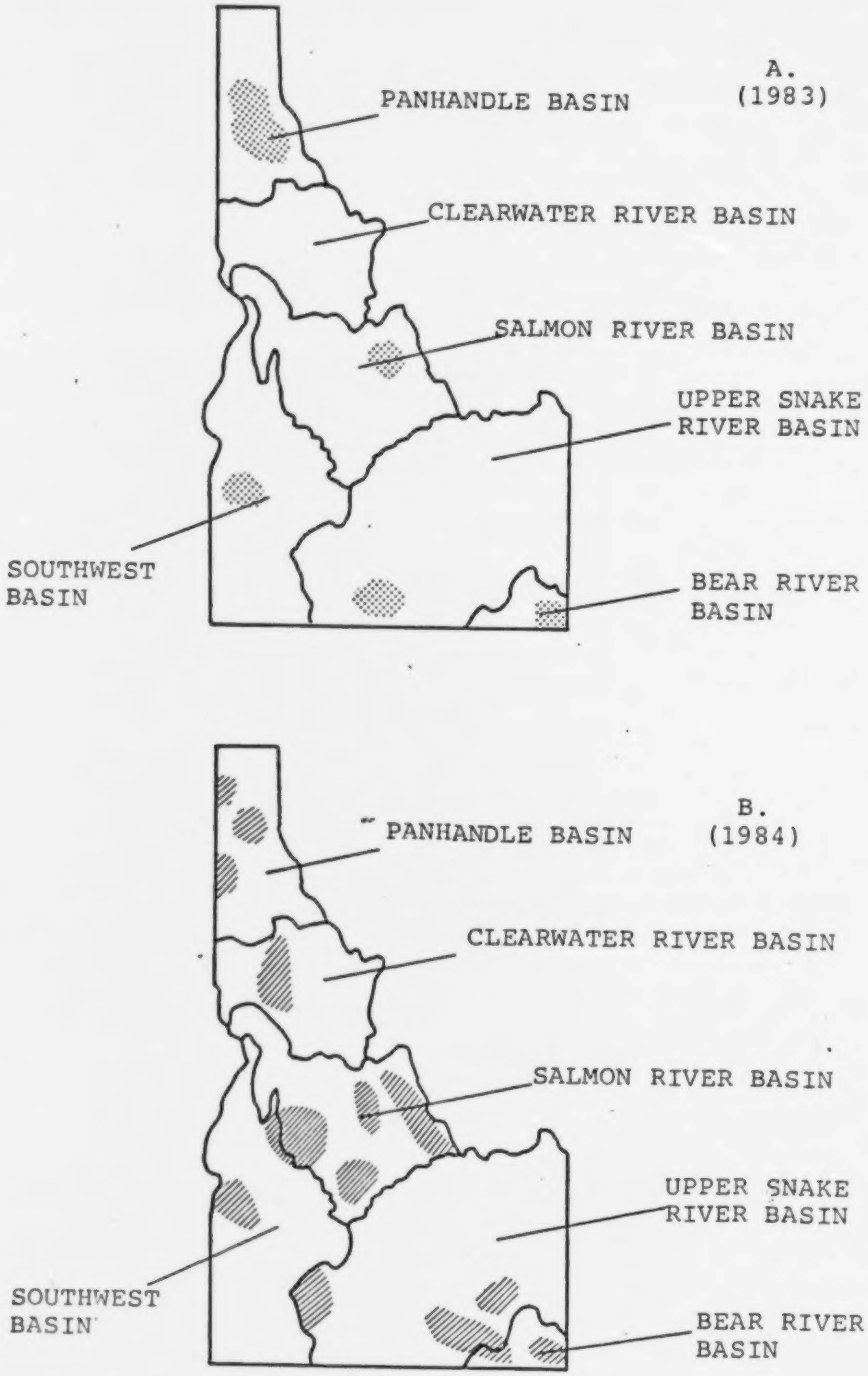
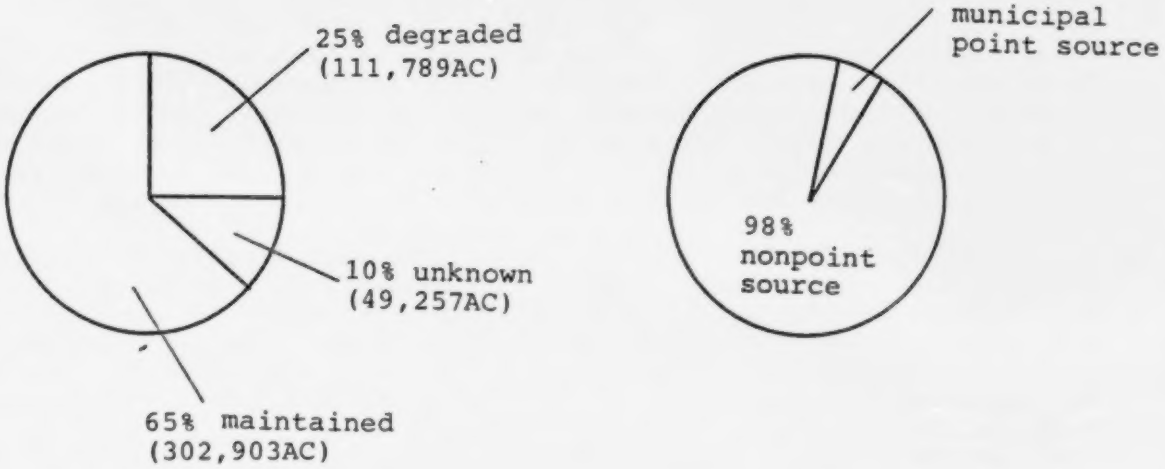

A.
(1983)
PANHANDLE BASIN
CLEARWATER RIVER BASIN
SALMON RIVER BASIN
UPPER SNAKE RIVER BASIN
SOUTHWEST BASIN
BEAR RIVER BASIN
B.
(1984)
PANHANDLE BASIN
CLEARWATER RIVER BASIN
SALMON RIVER BASIN
UPPER SNAKE RIVER BASIN
SOUTHWEST BASIN
BEAR RIVER BASIN

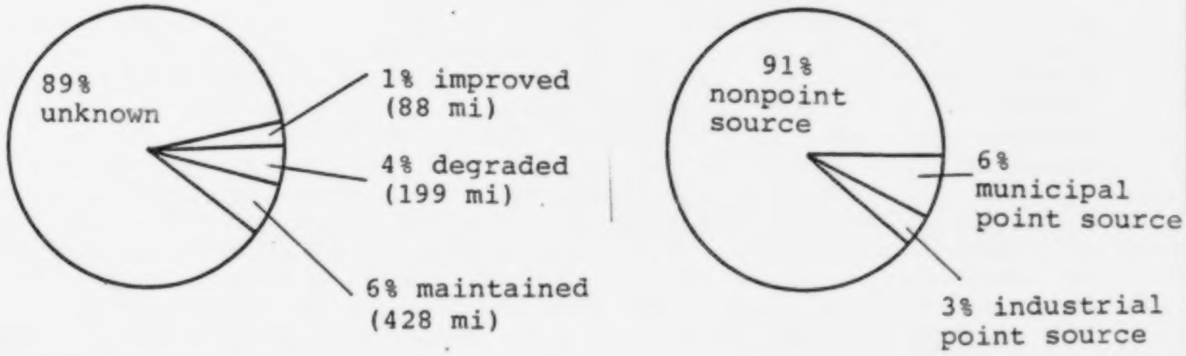
FIGURE 2-3. HIGH PRIORITY WATER QUALITY AREAS

SOURCES: IDHW 1983A; IDHW 1984B



Water Quality/Use Support (1972-1982)
in Idaho Lakes

Pollution Sources (1982)
Impacting Idaho Lakes



Water Quality/Use Support (1972-1982)
in Rivers and Streams

Pollution Sources (1982)
Impacting Idaho
Rivers and Streams

FIGURE 2-4. POLLUTION SOURCES AND GENERAL TRENDS IN LAKE, RIVER, AND STREAM SEGMENTS

discharge or by discharge via a ditch or other man-made device. Because operations meeting this definition are so numerous, across-the-board enforcement (or even an across-the-board inventory of all sources within this size-class) is not feasible with present manpower. Enforcement effort would produce the greatest benefit if it is focused on selected high-priority areas where water quality impact from dairies and feedlots is greatest and on areas containing dairies and feedlots that are considered sensitive for various reasons.

Emphasis should be placed on particular drainage basins rather than initiating random enforcement or reacting only to crisis situations. River segments are identified in the Idaho Water Quality Standards. Each smaller segment generally drains a particular area, and improvement will be measurable within the segment if a concentrated effort is made in the drainage. Concentration on selected drainages will also be more cost- and time-effective, will produce a more impartial enforcement effort, and will result in better public relations because farmers will not be singled out from their neighbors.

A drainage may be considered a priority or sensitive area for several reasons. Areas supporting unique resources, areas of high value to aquatic resources or supporting sensitive water quality uses, and areas where water quality and beneficial uses are impaired because of feedlot or dairy discharges may all be considered sensitive or high priority. A drainage area may also be considered sensitive or priority because of physical or geographical characteristics, such as location above important groundwater resources or proximity to population centers. Stream segments not meeting water quality standards, or segments where large concentrations of dairies or feedlots have discharges and/or direct access to the surface waters, should also be considered priorities. The various possibilities for priority designation are described below, and summarized as a group in Table 2-16.

Segments Where Dairies and Feedlots Cause Water Quality or Use Impairment

The IDHW Water Quality Index formerly provided a way to prioritize streams based on actual monitoring data. While river monitoring data are not current (the most recent is mid 1983), IDHW considers 1983 values fairly representative of current conditions (Sheppard pers. comm.). While this index allows a qualitative comparison of stream segment quality, it does not indicate the sources responsible for degradation. Prioritizing dairy and feedlot enforcement action, based only on segment quality, will not ensure stream improvement if the majority of the pollution is caused by other sources. An alternative is to prioritize water segments in terms of potential pollution from feedlots and dairies. This can be done by analyzing the condition, number, and size of animal confinement areas which drain to each stream segment.

Six major drainage basins exist within the state (Figure 2-5). The aerial survey covered a large portion of the three southern basins (Southwest Idaho, Upper Snake, and Bear River Basins). Animal confinement data for many (but not all) segments along Snake River drainages in these basins are thus available. No similar aerial surveys are presently available for other areas of the state. The survey cannot be expected to assess impact with complete accuracy; many small dairies and feedlots not included in the aerial survey may cumulatively have significant impact. Certain areas do seem to warrant greater concern than others, however, based solely on the number of operations observed draining to a particular river segment.

The sources draining to river segments within the three basins covered by the aerial survey are summarized by size and number in Table 2-10. As the aerial survey did not include many sources, this table underestimates numbers. Nevertheless, it provides some relative information by which to compare river segments in the Upper Snake, Southwest Idaho, and Bear River Basins of southern Idaho, the areas where dairies and feedlots are most concentrated.

Southwest Idaho Basin. The aerial survey in the Southwest Idaho Basin indicates segment SWB 280 (Boise River from Caldwell to mouth), segment SWB 340, (Payette River from B.C. Dam to mouth) and segment SWB 20 (Snake River from Strike Dam to the Boise River) to be the most potentially impacted by dairies and feedlots. The majority of the larger (over 200 animal) farms are located within these drainages. Many have no impoundments and often allow direct animal access or lie within short distance of a waterway. This finding tends to support IDHW's index values and the contention that the lower Boise is one of the worst water quality segments in the state. It also tends to support the assumption that control of agricultural sources in general within these segments should be a priority. These segments have respective water quality indices of 67.20 (very poor; severely polluted) 37.00 (fair; moderately polluted) and 31.30 (fair; moderately polluted) (IDHW 1984c).

Upper Snake Basin. The aerial survey in the Upper Snake Basin indicates Deep Creek (USB 810), the Big Wood (USB 850), and Little Wood Rivers (USB 871) to be most potentially impacted by feedlots and dairies, although a great number of sources were missed in this region. Cedar Draw creek, although not shown by the aerial survey to have an abnormally large number of dairies and feedlots, is estimated to have 20 percent of its impact from these sources (IDHW 1985c). Rock and Mud Creeks (USB 510 and USB 800) are also heavily impacted (McMasters pers. comm.), and all five of these creeks should be

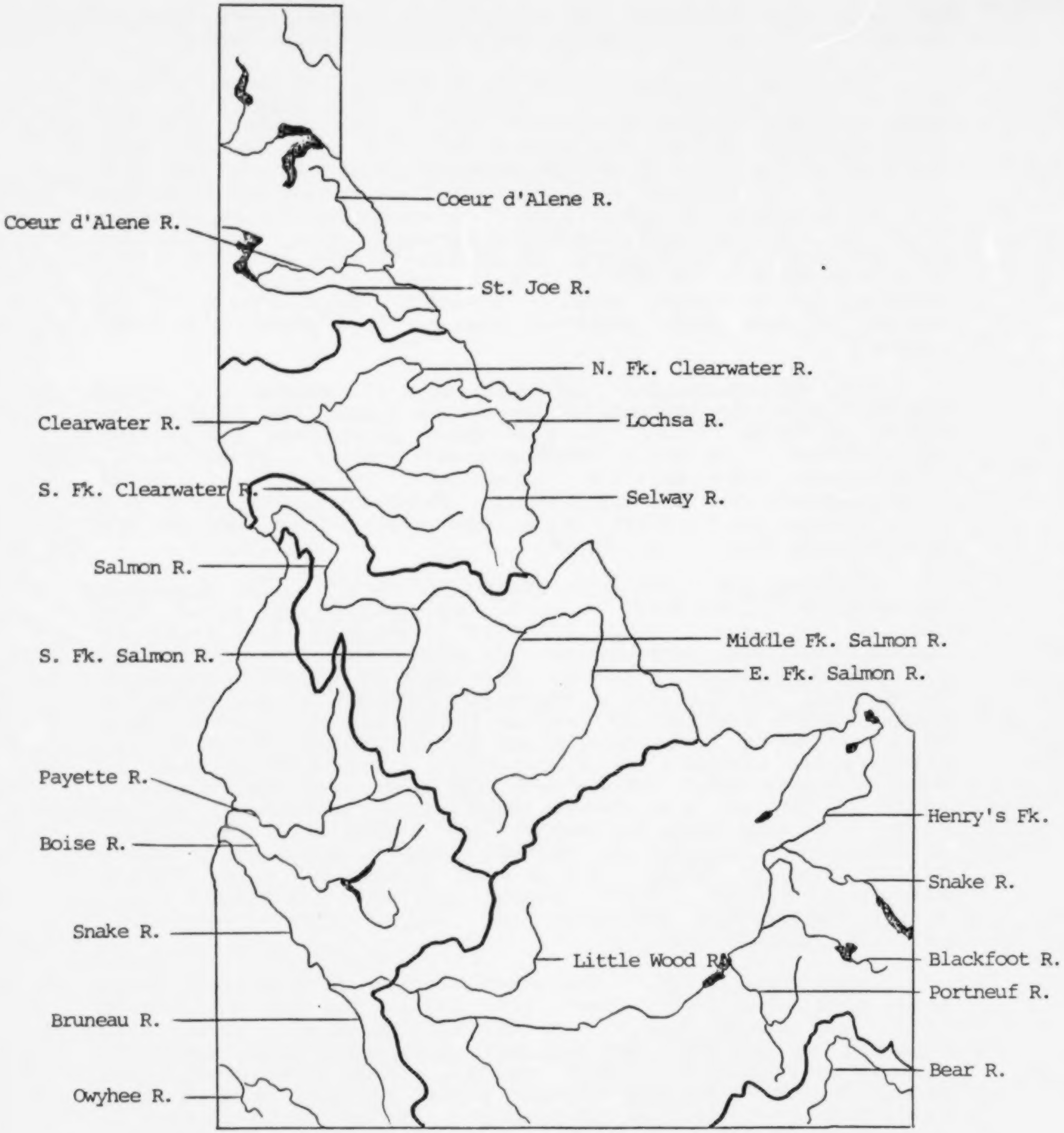

Coeur d'Alene R.
Coeur d'Alene R.
St. Joe R.
N. Fk. Clearwater R.
Clearwater R.
Lochsa R.
S. Fk. Clearwater R.
Selway R.
Salmon R.
Middle Fk. Salmon R.
S. Fk. Salmon R.
E. Fk. Salmon R.
Payette R.
Henry's Fk.
Boise R.
Snake R.
Snake R.
Little Wood R.
Blackfoot R.
Portneuf R.
Bruneau R.
Bear R.
Owyhee R.

FIGURE 2-5. MAJOR DRAINAGE BASINS AND RIVERS IN IDAHO.

Table 2-10. Number and Size of Farms Identified by Survey as Correlated to Receiving Water Segment

SEGMENT NUMBER		FARM SIZE				
		<50	51-200	201-700	701-1000	>1000
	Caldwell Survey Area					
SWB 420	Weiser R (Midvale-mouth)					1
SWB 340	Payette R (Black Canyon Dam-mouth)			2	1	
SWB 30	Snake R (Payette R-Boise R)					1
SWB 280	Boise R (Caldwell-mouth)			1		2
SWB 20	Snake R (Strike Dam-Boise R)		1	1		4
SWB 270	Boise R (Mile 50-Vet State Park)	1				
SWB 10	Snake R (King Hill-Strike Dam)	1				2
	Twin Falls Survey Area					
USB 520	Raft R (Source-mouth)		1			
USB 60A	Snake R (Minikoka Dam-Hey/Bur Br)		2			
USB 60B	Snake R (Hey/Bur Br-Milner Dam)		1			
USB 70	Snake R (Milner Dam-Buhl)		1			
USB 730	Rock Cr (Rock Cr City-mouth)	1	1	1		
USB 740	Cedar Draw (Source-mouth)	1	2	1		
USB 810	Deep Cr (Source-mouth)	2	7			
USB 820	Salmon Falls Cr (ID/NV border-mouth)		1	1		
USB 850	Big Wood R (Source-Magic Res)	3	12			1
USB 80	Snake R (Buhl-King Hill)	2	6	1		
USB 871	Little Wood R (Source-Richfield)	2	10			
USB 840	Billingsley Cr (Source-mouth)		1			
	Blackfoot Survey Area					
USB 30	Snake R (Roberts-Am Falls Res)	1			1	
USB 40	Snake R (Am Falls Res)				1	
USB 411	Marsh Cr (Source-mouth)		1			
BB 471	Little Malad R (Source-mouth)	3				
BB 410	Mink Cr (Source-mouth)	2	3			
BB 430	Worm Cr (Source-ID/UT border)	1	3			
BB 450A	Cub R (Mapleton-Franklin)	6	2	1		
BB 30	Bear R (Soda Sp-UPL Tailrace)	7	6	1		

Note: Although 298 operations were identified by the aerial survey, many (particularly in the Twin Falls area) discharge to canals or ditches which appear to have no discharge to creeks or rivers. These operations are omitted from this table.

considered priority. These segments had water quality indices of 49.10 (poor; polluted), 7.30 (very good) and 13.70 (good; minimally polluted), respectively (IDHW 1984c).

Bear River Basin. The aerial survey in the Bear River Basin indicates the Bear and Cub Rivers (BB 30 and BB 450A) and Mink and Worm Creeks (BB 410 and BB 430) receive heavy dairy and feedlot impact in this basin. This agrees with IDHW information supplied through personal communications. Degradation in these areas results from a cumulative impact of numerous small sources. These areas should be considered priority areas for feedlot and dairy concerns. Water quality index values for these segments were 22.60 (fair; moderately polluted) 27.60 (fair) 28.50 (fair) and 50.00 (poor), respectively (IDHW 1984c).

The more northern areas of the state, which contain the Salmon, Clearwater, and Panhandle Basins were not aerially surveyed, so a comparison of stream segments based on actual number and size of operations cannot be made. Information for these basins was obtained from discussions with IDHW and other agency personnel as well as available literature.

Salmon River Basin. Although no aerial survey data are available for the Salmon River Basin, IDHW personnel believe dairies and feedlots are of little relative concern. The high water quality supports one of the last wild anadromous fisheries in the contiguous United States. Impacts in the basin are primarily caused by mining, silviculture, and recreation. The IDHW water quality status report (1984c) does indicate, however, that many feedlots are concentrated along Rapid River, Whitebird Creek, Rock Creek and the Salmon River from Riggins to the mouth. These segments should be considered as priority segments for feedlot and dairy wastes within the basin, at least until impacts can be quantified. Water quality index values for these segments were 8.50 (very good) 34.00 (fair, moderately polluted) and 77.90 (very poor; severely polluted) respectively (IDHW 1984c) (no ranking was available for the Salmon River segment).

Clearwater Basin. Although no aerial survey data are available for the Clearwater Basin, Lindsay Creek (CB 210) and Tammany Creek (CB 110) are specifically known to be impacted by dairies and feedlots. Most operations in these areas are quite small. Areas in drainages along the Palouse River are also affected by cattle, but these are primarily free-ranging cattle (Moeller pers. comm.). Priority in this basin should be placed on Lindsay and Tammany Creeks. Water quality index values for these segments were 75.00 and 79.30, respectively (both very poor; severely polluted).

Panhandle Basin. In the Panhandle Basin, there are scattered feedlot and dairy operations, but no areas that are particularly impacted by dairies and feedlots. Silviculture and other activities are of much greater concern. No priority areas, based on dairy or feedlot impact, are identified at present.

IDHW Designated High Priority Segments

The river segments in each drainage basin that are considered of highest priority by IDHW are listed in Table 2-11. Uses protected for general and future use in these segments are indicated in Table 2-12. The IDHW high priority segment designations include segments having both high water quality (which should be maintained) and poor water quality (which should be improved). Factors considered by IDHW in designating a priority stream segment include: the potential for stream cleanup; the historical uses of a segment; the maintenance or enhancement of beneficial uses, such as recreation, wildlife or fish habitat; the degree to which an area is threatened by ongoing or future development; and other factors. Within some basins, dairy and feedlot discharges are responsible for little or no impact. But future sources should be evaluated with the priority designation in mind to ensure water quality is not degraded. The IDHW priority list varies slightly from year to year, depending on needs, funding, ongoing restoration projects, water quality, and other factors.

Upper Snake Basin. River segments within the Upper Snake Basin support a number of beneficial uses, including domestic and agricultural water supply, recreation, coldwater fisheries, and salmonid spawning (IDHW 1983b). Overall water quality in this basin is rated fair by IDHW (1984b). The pollutants of greatest threat to these uses are bacteria, nutrients, and solids, all of which are generated by animal wastes. Within this basin, the progressive westward degradation is caused primarily by agricultural activities.

IDHW has identified eight priority river segments (and two groundwater areas) within the Upper Snake Basin: Deep, Cedar Draw, Billingsley, and Rock Creeks; the Portneuf River; and Magic and Island Park Reservoirs (IDHW 1984b). Groundwaters include the Snake River Aquifer and groundwater in Cassia and Twin Falls Counties. The river segments were designated high priority for various reasons, including maintenance and improvement of water quality and protection of aquatic resource values. Many of these segments are also listed as being "special resource waters" in the Idaho Water Quality Standards.

Deep and Cedar Draw Creeks (USB 810, 740) are heavily impacted by dairy wastes, which cause an estimated 20 percent of the impacts (IDHW 1984b). Rock Creek (USB 730) quality is also heavily impacted by dairy wastes. Billingsley Creek (USB 840; also considered a special resource water) has an outstanding recreational and fisheries value. Nutrients

Table 2-11. IDHW Priority Water Segments by Basin

	SOURCES OF IMPACTS												
	NONPOINT SOURCES											POINT SOURCES	
	Irrigated Agriculture	Dryland Agriculture	Grazing	Silviculture	Mining	Road Construction	General Construction	Urban Runoff	Residual Waste Disposal	Hydrologic Modification	Other	Municipal	Industrial
BEAR RIVER BASIN													
BB 430 Worm Creek		70%											
BB 471 Little Malad	30%f	70%											
BB 4503 Cub River		90%									10%b		
BB 10 Bear River	20%	20%	40%								20%f		
BB 120 Bear Lake and Outlets	10%	5%	75%				10%						
UPPER SNAKE BASIN (Twin Falls)													
USB 840 Billingsley Creek	20%		15%				5%				10%c		50%a
USB 810 Deep Creek	60%		10%				5%				20%b		5%a
USB 740 Cedar Draw Creek	60%		10%								20%b		10%a
USB 660 Magic Reservoir	20%	30%	15%				20%				10%c	15%	
USB --- Groundwater; Cassia and Twin Falls Counties													100%a
(Pocatello)													
USB --- Snake River Aquifer	30-40%												60-70%a
USB 420 Portneuf River	20%	30%	20%				20%	10%					
USB 410 Portneuf River		40%	50%									10%	
USB 510 Rock Creek		50%	40%									10%	
USB 220 Island Park Reservoir						10%	90%						
SOUTHWEST BASIN													
SWB 270 Boise River	30%		10%					10%			30%b	20%	
SWB 324 N.F. Payette River			40%	10%		10%						40%	
SWB 310 S.F. Payette River				10%	10%	80%							
SWB 340 Payette River	50%		10%								30%b	10%	
SWB 233 Jordan Creek			40%		40%	20%							
SALMON BASIN (Pocatello)													
SB 421 Blackbird Creek					100%								
SB 430 Panther					100%								
SB 310 Lemhi River	50%		50%										
SB 120 E.F. Salmon River	10%	10%	40%		30%						10%e		
SB 110 Yankee Fork					90%	10%							
(Boise)													
SB 511 EFSF Salmon River					75%	25%							
SB 441 Monumental Creek					95%	5%							
CLEARWATER BASIN													
CB 154 Potlatch River		35%	5%	15%	5%	5%	5%	5%	5%	5%	5%	5%	5%
CB 141 Lawyers Creek		30%	5%	5%		30%	5%	5%	5%	10%		5%	
CB 151 Big Canyon Creek		40%	5%	10%		15%	10%		15%	5%			
CB 156 Lapwai Creek		30%	20%	10%		10%	5%		5%	5%	5%		5%
CB --- Moscow Aquifer			UNKNOWN							UNKNOWN			
PANHANDLE BASIN													
PB 20P Lake Pend Oreille								5%			90%f	5%	
PB 30P Lake Coeur d'Alene		75%		10%	10%								
PB 430S Hayden Lake								25%	75%				
PB 420S Twin Lakes					25%				75%d				
PB 340P Priest Lake (East side and tributaries)							100%						

a - Land Application
b - Feedlots and Dairies
c - Fish Hatcheries
d - Subsurface Sewage Disposal
e - Natural Channel Instability
f - Upstream Sources

Table 2-12. Designated Uses of Priority Water Segments in Idaho

	DOMESTIC WATER SUPPLY	AGRICULTURAL WATER SUPPLY	COLDWATER BIOTA	SALMONID SPAWNING	PRIMARY CONTACT REC.	SECONDARY CONTACT REC.	SPECIAL RESOURCE
			BEAR RIVER BASIN				
BB 430 Worm Cr		x	(x)	(x)	(x)	x	
BB 471 Little Malid R		x	(x)	(x)	(x)	x	
BB 450B Cub R		x				x	
BB 10 Bear R		x	x	x	x	x	
BB 120 Bear Lk & Outlets		x	x	x	x	x	
			UPPER SNAKE BASIN				
USB 840 Billingsley Cr	x	x	x		x	x	x
USB 810 Deep Cr		x	x	x		x	
USB 740 Cedar Draw Cr		x	x	x		x	
USB 860 Magic Res		x	x		x	x	
USB --- Groundwater; Cassia & Twin Falls Co.'s	-	-	-	-	-	-	-
USB --- Snake R Aq	-	-	-	-	-	-	-
USB 420 Portneuf R		x	(x)	(x)	(x)	x	
USB 410 Portneuf R	x	x	x	x	x	x	x
USB 510 Rock Cr		x	x	x	x	x	
USB 220 Island Pk Res	x	x	x	x	x	x	x
			SOUTHWEST BASIN				
SWB 270 Boise R		x	x	(x)	x	x	
SWB 324 NF Payette R	x	x	x	x	x	x	
SWB 310 SF Payette R	x	x	(x)	(x)	x	x	x
SWB 340 Payette R	x	x	x	x	x	x	x
SWB 233 Jordan Cr		x	x	x	x	x	x
			SALMON BASIN				
SB 421 Blackbird Cr			(x)			x	
SB 430 Panther Cr		x	x			x	
SB 310 Lemhi R	x	x	x	x	x	x	x
SB 120 EF Salmon R	x	x	x	x	x	x	x
SB 110 Yankee Fk	x	x	x	x	x	x	x
SB 511 EFSF Salmon R	x	x	x	x	x	x	x
SB 4411 Monumental Cr[a]	x	x	x	x	x	x	x
			CLEARWATER BASIN				
CB 154 Potlatch R	x	x	x	x	x	x	x
CB 141 Lawyers Cr		x	x	x	x	x	
CB 151 Big Canyon Cr		x	x	x	x	x	
CB 156 Lapwai Cr		x	x	(x)	x	x	
CB --- Moscow Aq	-	-	-	-	-	-	-
			PANHANDLE BASIN				
PB 20P Lk Pend Oreille	x	x	x	x	x	x	x
PB 30P Lk Coeur d'Alene	x	x	x	x	x	x	x
PB 430S Hayden Lk	x	x	x	x	x	x	x
PB 420S Twin Lks	x	x	x	(x)	x	x	
PB 340P Priest Lk (east side & tributaries)	x	x	x	x	x	x	x

---

x Protected for general use.

(x) Protected for future use.

- Groundwater .

[a] Uses shown are for Big Creek, the receiving waters.

SOURCE: IDHW 1983b, 1984b.

are a problem present in this creek. Any feedlots and dairies are likely to aggravate this problem, although livestock impacts are primarily from pasturing, not dairies or feedlots.

The Portneuf River (USB 410, 420; also designated a special resource water) is considered good fisheries habitat but is impacted by dryland agriculture and grazing. There are also some dairy and feedlots in the upper and lower reaches (Torf pers. comm.). Island Park Reservoir (USB 220) has outstanding water quality and is also a source for Henry's Fork, a "blue ribbon" trout fishery. It also supports waterfowl and a variety of recreational and habitat uses, including support of cutthroat trout in some areas.

Magic Reservoir (USB 860) is an important recreational area presently impacted by various agricultural activities, including irrigated and dryland farming and grazing, as well as road construction and other activities.

Southwest Basin. River segments in the Southwest Basin support recreational activity, coldwater fisheries, and salmonid spawning, as well as domestic use (IDHW 1983b). Overall water quality in this basin is rated fair by IDHW (1984b). Both point and nonpoint sources contribute to use impairment, although it is believed that agricultural activity is the primary cause of degradation and that the greatest potential water quality benefits would result from improvement of agricultural management practices (IDHW 1983b).

IDHW has identified five high priority segments within this basin: the Boise and Payette Rivers (SWB 280, 340), North and South Fork Payette (SWB 324, 310), and Jordan Creek (SWB 233). The Boise and Payette are designated as high priorities because they are heavily impacted by irrigated agriculture, runoff, and a number of other sources. Feedlots and dairies are responsible for an estimated 30 percent of the impact in both rivers (IDHW 1984b). Of the two, the Boise has higher priority with IDHW (Sheppard pers. comm.). The North Fork and South Fork Payette were both considered high priority segments because of existing impacts to these segments. The North Fork has highest priority primarily because of citizen concern and involvement. The drainage is heavily grazed, and the receiving water (Cascade Reservoir) already has some nutrient and bacterial problems. Approximately 80 percent of the impact to the South Fork is caused by road construction. This segment is of less priority than the North Fork. Jordan Creek was designated as a priority segment because it supports a fishery and is impacted by many sources, including grazing and mining. This segment has lowest priority of the five segments chosen from this basin (Sheppard pers. comm.).

Bear River Basin. River segments in the Bear River Basin support a number of beneficial uses, including agricultural water supply and contact recreation (IDHW 1983b). Uses of greatest concern are fishing and recreation. Water quality in this basin is rated poor (IDHW 1984b). IDHW has identified five high priority segments in this basin: Worm Creek (BB 430); the Little Malad (BB 471), Cub (BB 450B), and Bear Rivers (BB 410); and Bear Lake (BB 120). These were designated because of the existing water quality concerns and their use as recreational areas. All of these rivers have dairy and feedlot impacts. The Cub River is the only high priority segment IDHW indicates as having impact from these sources (Table 2-11), but the aerial survey and discussions with state personnel indicate dairy and feedlot impact is considerable on these other segments as well.

Because the Bear River is the major tributary to Bear Lake, it directly affects water quality in the lake, and nutrient and sediment loading are of concern. Bear Lake is the focal point for recreation and fishing in the basin. In 1983, a Clean Lakes Project was completed for Bear Lake, and three-state funding is being sought to implement a basin management plan to improve water quality in the drainage.

Water quality entering the basin at the Wyoming-Idaho border is affected by sediment, high turbidity, and phosphorus levels. Nitrates from natural springs and municipal discharges, and bacteria from agricultural drainage and municipal discharges both increase in downstream segments of the basin. The drainage has naturally high dissolved solids levels compared to other basins because of salt springs near Preston. Although point sources include municipal effluent from Preston and Soda Springs, the major water quality impact comes from agricultural pollution (IDHW 1981, 1983a). Seasonal highs of bacteria, sediment, turbidity, and phosphorus correspond to periods of runoff.

Salmon River Basin. River segments in the Salmon River Basin support a number of beneficial uses, including domestic water use, recreational activity, and fisheries (IDHW 1983b). Water quality in this basin is generally very good, although mining impacts have destroyed fisheries in several segments (IDHW 1983a). Seven river segments are currently considered priority segments by IDHW: Blackbird, Panther, and Monumental Creeks (SB 421, 430 and 441); the Yankee Fork (SB 110); the East Fork South Fork Salmon River (SB 511); the Lemhi River (SB 310) and East Fork Salmon River (SB 120). Impacts in these segments are caused by nonpoint sources, particularly mining, grazing, and irrigated agriculture. Recreational impacts also elevate bacterial levels in the middle and main forks of the Salmon River. The priority listing (IDHW 1984b) notes no segments where impact can be specifically attributed to dairies and feedlots.

Many waters in the Salmon River Basin are also considered special resource waters because of their high quality. The Lemhi River drains to the Salmon River (parts of which are designated as a Wild and Scenic River). It is considered a high priority segment because it is a historical source for anadromous fish habitat, and it is presently impacted by irrigated agriculture and grazing. The East Fork Salmon is considered high priority because of grazing and mining impacts. The East Fork South Fork is designated as a priority segment because it is impacted by a stibnite mine at the headwaters, as well as road construction. Monumental Creek is newly designated as a high priority segment. Yankee fork is also impacted by both mining and road construction. It supports steelhead and salmon spawning and provides a corridor into the wilderness area. Several mines are also located in the area. Blackbird and Panther Creeks were historical salmon habitat, and both are impacted primarily by mining. Of these, Panther Creek probably has more potential for restoration. Dairies and feedlots are presently of little concern in these segments (Torf pers. comm.).

Clearwater Basin. River segments in the Clearwater Basin support a number of uses, including domestic and agricultural water supply, contact recreation, and coldwater biota (IDHW 1983b). Overall water quality in this basin is considered generally good, although nonpoint sources and municipal discharges in the lower drainage have some impact (IDHW 1983a). IDHW has identified four high priority stream segments and one groundwater area in this drainage: the Potlatch River and Lawyers, Big Canyon, and Lapwai Creeks (CB 154, 141, 151 and 156). All are primarily impacted by dryland agriculture and various other sources. The Moscow Aquifer is also considered a priority area in this basin. This drainage supports both hatchery and wild anadromous fisheries and is an important recreation area as well. The latest IDHW water quality report notes no high priority areas presently impacted by dairies and feedlots.

Big Canyon Creek is presently the object of a large three-district planning project. It contains excellent steelhead and chinook potential. It is also threatened by potential impacts from timber harvesting. The Lapwai Creek has high recreational and anadromous fish value. The Nez Perce Indians also have a hatchery at the mouth. The creek drains to Winchester Lake, considered a special resource water because of its fisheries value (IDHW 1984b). The Potlatch River is considered high priority because it drains directly into Granite Reservoir and has anadromous fishery potential. This is of lower priority than some of the other segments because it is so badly degraded, and it will be difficult to clean it (Moller pers. comm.). Cattle account for less than 5 percent of the impacts. Lawyers Creek is impacted by dryland agriculture, road construction, and several other sources. It is also of lower priority than segments such as Big Canyon or Lapwai (Moller pers. comm.).

Panhandle Basin. River segments in the Panhandle Basin have some of the highest water quality in the state. They support a number of varied uses, including salmonid spawning, domestic and agricultural water supply, coldwater biota, and contact recreation (IDHW 1983b). Overall water quality in the basin is considered to be good to excellent (IDHW 1983a, 1984b). IDHW has identified five high priority segments (all lakes) in this basin: Pend Oreille, Coeur d'Alene, Hayden, Twin, and Priest Lakes (PB 20p, 30p, 430s and 340p). Mining, silviculture, dryland agriculture, construction, and residual waste disposal are the primary impacts on these waterbodies. These lakes are all considered high priority for preservation purposes because of their high water quality, recreational value, and fish habitat (Van Curen, Beckwith pers. comm.). Dairy and feedlot impacts are very low in this basin, and no streams (high priority or otherwise) were identified as having great impact from these sources (Beckwith pers. comm.).

Segments with Wild and Scenic River Status

Several rivers within the state have been accorded Wild and Scenic River status under the Wild and Scenic Rivers Act, PL 90-542 as amended. Many others are presently considered as potential additions. These segments should be considered as sensitive areas. Few dairies or feedlots impact these areas at present, but effort should be made to ensure that future operations do not decrease water quality. Present and proposed Wild and Scenic segments are located in the panhandle, Clearwater, Salmon River and Southwest Idaho basins. Their status and areas of designation are listed in Table 2-13.

High Priority Aquacultural Areas.

Aquaculture generally requires high quality water having dissolved oxygen levels sufficiently high (generally above 5 mg/l) to support fisheries. Dairy and feedlot wastes can drastically reduce dissolved oxygen levels, and discharges from these operations have been noted to cause fish kills. Because of the concentrated nature of hatcheries, large numbers of fish would be impacted if a discharge were to affect the hatchery water source.

There are 24 state-owned and 3 federally-owned hatcheries in Idaho, in addition to a large number of privately owned operations. The majority of the state hatcheries receive their water from springs or wells and are not likely to be affected by feedlot or dairy discharges. Only a few are dependent on stream water. These include state hatcheries at Hagerman (using Riley and Tucker Creeks), Ashton (Black

Table 2-13. Wild and Scenic River Segments

PRESENTLY DESIGNATED

Clearwater, middle fork:

Kooskia upstream to Lowell
Lochsa River from the Selway junction upstream to Powell Ranger Station
Selway River from Lowell upstream to its origin

Salmon, middle fork:

Origin to confluence with the main Salmon River

Rapid:

Headwaters of the main stem to the national forest boundary
West fork from the wilderness boundary to the confluence with the main stem (wild river)

Snake:

Hells Canyon Dam downstream to Pittsburgh Landing (wild river)
Pittsburgh Landing downstream to the eastern extension of T5N, R47E, S1 (scenic river)

Saint Joe:

Above the confluence of the North Fork to Spruce Tree Campground (recreational river)
Above Spruce Tree Campground to Saint Joe Lake (wild river)

Salmon:

Main river from mouth of the North Fork downstream to Long Tom Bar (recreational and wild segments)

POTENTIAL ADDITIONS

Bruneau - entire main stem
Moyle - Canadian border to confluence with the Kootenai River
Priest - entire main stem Saint Joe - entire main stem Salmon
- town of North Fork to confluence with the Snake River Snake
- from eastern extension to T5N, R47E, S1 downstream to Asotin

Springs), Pahsimeroi (Pahsimeroi River); Sawtooth (upper Salmon River), Oxbow (Snake River), McCall (Payette River), Mullen (S.F. and little N.F. Coeur d'Alene), Rapid River (Rapid River) and the East and South Fork Traps (Salmon River). Federal hatcheries at Davorshak and Kooskia obtain water from the Clearwater River and Clear Creek, respectively (Huffaker pers. comm., IDHW Hatchery inventory forms). All hatcheries except for the Hagerman hatchery are located in central and Northern Idaho, where feedlots and dairies are less concentrated.

The majority of private trout hatcheries are located in the upper Snake Basin in southern Idaho. This area produces 90 percent of the nation's commercial trout. Of the 94 operations permitted there, 47 obtain their source water from springs or seeps. The remaining half obtain water from canals or creeks. This latter group is most susceptible to impacts from dairy or feedlot discharges. Table 2-14 lists creeks and canals supplying water to hatcheries, the number of hatcheries on each creek, and the production capacity. Although all streams supporting aquaculture projects should be considered priority areas, Riley, Billingsley, and Box Canyon creeks and Alpheus, Crystal and Niagara springs are particularly important because they support such a high potential production. Pospisil Drain, Briggs, Cedar Draw, Deep, Cassiz and Slaughterhouse creeks, and Three, Weatherby, Saddle, Tupper, Curren and Tucker springs also support large potential production.

Segments with Species that are Threatened, Endangered or of Special Concern

There is one endangered fish species in Idaho - the sockeye salmon (*Oncorhynchus nerka*) which is restricted in range to Redfish Lake, to the east of Boise. Two threatened groups, the "summer" and "fall" chinook salmon (*O. tshawytscha*) are approaching endangered status. These are found in the Snake River below Shoshone Falls. Nineteen species are also designated as being species of special concern by the Department of Fish and Game. These include the white sturgeon, turbot, twelve species and subspecies in the trout family (salmon, trout, cisco, whitefish), the leatherside chub, three sculpin species, and the sand roller. Most are restricted in range to small areas. Five species (Bear Lake Cutthroat, Bear Lake Whitefish, Bonneville cisco, Bonneville whitefish, and Bear Lake sculpin) are restricted in range to Bear Lake (BB 120). The Wood River sculpin and Leatherside chub are restricted in range to the Wood River. The sand roller is restricted to the Clearwater River near Lewiston, the turbot to the Kootenai River, the Snake River cutthroat to the South Fork Snake, the Bonneville cutthroat to Preuss, Giraffe and Dry Creeks, the Sunapee Trout to Alpine lakes in the Sawtooth Range, and the Shoshone sculpin to the Snake River aquifer

Table 2-14. Creeks, Springs, and Canals Supporting Fish Hatcheries in South Central Idaho[1]

WATERBODY	NUMBER OF HATCHERIES	PRODUCTION CAPACITY (LBS/YR)
Deep Cr.	2	384,000
Silo Cr.	2	192,000
Mud Cr.	2	480,000
Pospisil Dr.	4	498,000
I. Coulee	1	108,000
Crystal Sp.	2	4,560,000
Cedar Draw	2	684,000
Coulees 1-3, 14	1	24,000
L Q Coulee	1	216,000
Alpheus Cr.	2	2,556,000
E Coulee	1	192,000
Slaughterhouse Cr.	1	360,000
Rock Cr.	1	?
Riley Cr.	4	2,352,000
Stoddard Cr.	1	180,000
Birch Cr.	1	120,000
Billingsley Cr.	5	4,135,200
Saddle & Tupper Sp.	1	840,000
Three Sp. & Weatherby Sp.	1	876,000
Spring Cr. Sp.	2	108,000
Curren Sp.	1	480,000
Hewitt Sp.	1	192,000
Tucker Sp.	1	420,000
Box Canyon Cr.	1	3,600,000
Clear Sp.	1	?
Briggs Sp.	1	840,000
Niagara Sp.	2	2,280,000
Cassiz Cr.	1	360,000

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[1] Forty-seven additional hatcheries obtain their water from unnamed springs, seeps or wells.

SOURCE: Twin Falls IDHW fish rearing inventory forms.

springs. Some discrete river stocks of the steelhead may be in the "threatened" status, although it ranges throughout all of the river drainages. The white sturgeon is found only in the Kootenai drainage and in the Snake River below Shoshone Falls. The Bull trout is present in the majority of the major drainages (IDFG 1981). A listing of fish species that are endangered, threatened or of special concern in Idaho is given in Table 2-15.

The areas discussed above that are restricted range for threatened, endangered or sensitive species should be considered priority areas because of the potential impact wastes from these operations can have on fisheries.

High Priority Groundwater Areas

In considering feedlot and dairy waste management and impact options, surface water pollution should not be the only concern. The Panhandle Basin contains a portion of the Spokane Valley - Rathdrum Prairie Sole Source Aquifer, and a proposed Sole Source Aquifer; the Snake River Plain aquifer underlies much of the Snake River in southern Idaho. The Snake River plain small aquifer discharges via numerous springs in the area between Hagerman and Twin Falls. Many of these springs support aquaculture projects such as trout hatcheries. Citizens of Hagerman have petitioned the EPA to designate the aquifer (primarily in the area from Hagerman eastward to approximately St. Anthony) as a Sole Source Aquifer. This designation would require any federal projects in the area above the aquifer to undergo extensive review for possible impacts on the aquifer. In response to this petition, the Governor's Office requested that instead of federal designation, EPA allow the state to take an active role in aquifer protection. EPA is presently delaying further processing on the Snake Plain Sole Source designation, and the state has agreed to develop an aquifer protection plan that would go beyond the protective mechanism provided by a Sole Source designation. A planning strategy for the groundwater management plan is now in preparation. Initial problem solving and a proposal should be completed by October 1985. Federal agencies in the area have also voluntarily agreed to submit their proposed projects for review, although the designation is not in effect (Mullen pers. comm.).

Regardless of whether the Snake Plain aquifer eventually receives Sole Source status or whether it is managed under a state protection plan, its significance as a water source should be considered in evaluating activities occurring above it, particularly where underlying lava or other porous formations allow relatively rapid and unfiltered entrance of surface water into the aquifer.

Table 2-15. Fish Species that are Endangered, Threatened or of Special Concern in Idaho

COMMON NAME	SCIENTIFIC NAME	STATUS[1]	THREATS[2]	COMMENTS
STURGEONS -White sturgeon	Acipenser transmontanus	SC	1,6	Additional impoundment of present range could change status to "threatened"
CODFISHES -Burbot	Lota lota	SC	1,6	Restricted range - Kootenai River
TROUTS -Chinook salmon, "spring"	Oncorhynchus tshawytscha	SC	1,2,3,4,5	
-Chinook salmon, "summer"	Oncorhynchus tshawytscha	T	1,2,3,4,5	Approaching "endangered" status
-Chinook salmon, "fall"	Oncorhynchus tshawytscha	T	1,2,3,4,5	Approaching "endangered" status
-Sockeye salmon	Oncorhynchus nerka	E	1,3,5,6	Restricted range - Redfish Lake
-Steelhead trout	Salmo gairdneri	SC	1,2,3,4,5	Some discrete river stocks may be in "threatened" status
-Redband trout	Salmo sp.	SC	6	Restricted range; status unknown
-Sunapee trout	Salvelinus alpinus aureolis Bean	SC	6	Restricted range - alpine lakes in Sawtooth range
-Westslope cutthroat	Salmo clarki lewisi	SC	1,2	Sensitive to habitat modification and fishing
-Bonneville cutthroat	Salmo clarki Utah	SC	6	Restricted range - Preuss Creek, Giraffe Creek, Dry Creek
-Bear Lake cutthroat	Salmo clarki ssp.	SC	6	Restricted range - Bear Lake
-Snake River (fine spot) cutthroat	Salmo clarki ssp.	SC	6	Restricted range - South Fork Snake River
-Bear Lake whitefish	Prosopium abyssicola	SC	6	Restricted range - Bear Lake
-Bull trout (Dolly Varden)	Salvelinus confluentus	SC	6	Only native fish of this genus. Present in Idaho only as wild, native stocks.
-Bonneville cisco	Prosopium gemmiferum	SC	6	Restricted range - Bear Lake
-Bonneville whitefish	Prosopium spilonotus	SC	6	Restricted range - Bear Lake
MINNOWS -Leatherside chub	Snyderichthys copei	SC	6	Restricted range - Wood River; status unknown

Table 2-15. Fish Species that are Endangered, Threatened or of Special Concern in Idaho (continued)

COMMON NAME	SCIENTIFIC NAME	STATUS[1]	THREATS[2]	COMMENTS
SCULPINS				
-Bear Lake sculpin	Cottus extensus	SC	6	Restricted range - Bear Lake
-Shoshone sculpin	Cottus greenei	SC	6	Restricted range - Snake River aquifer springs; status unknown
-Wood River sculpin	Cottus leiopomus	SC	6	Restricted range- Wood River; status unknown
TROUT-PERCHES				
-Sand roller	Percopsis transmontana	SC	6	Restricted range - Clearwater River near Lewiston

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[1] E - Endangered Species: Any species in danger of extinction throughout all or a significant portion of its range.

T - Threatened Species: Any likely to become an endangered species within the foreseeable future in all or a significant portion of its range.

SC- Species of Special Concern: Species whose restricted range, specific habitat requirements and/or low population numbers makes them vulnerable to elimination from the state if adverse impacts on habitat or populations occur.

[2] 1 - The present or threatened destruction, modification, or curtailment of its habitat or range.
2 - Overutilization for commercial, sporting, scientific, or educational purposes.
3 - Disease or predation.
4 - The inadequacy of existing regulatory mechanisms.
5 - Other natural or manmade factors affecting its continued existence.
6 - Other (peripheral, restricted range, etc.).

SOURCE: IDFG 1981.

Because this aquifer extends over such a large area and feedlots and dairies are ubiquitous in this region, there seems little to be gained by listing all stream segments where dairies and feedlots could produce potential impacts. Groundwater impacts should be a consideration for all operations along the Snake River. The absence of containment facilities in many feedlots and dairies presently causes surface water pollution, but constructing inadequately sealed containment facilities may result in increased groundwater pollution, particularly by nitrates. A preventative approach is particularly important for groundwater, since groundwater pollution is generally much more difficult to clean up than surface water pollution. In determining the correct management of feedlot and dairy wastes, both surface and groundwater concerns must be considered on a site-specific basis.

At present, the impact of existing facilities on groundwater has not been quantified, and it is difficult to distinguish the impact of septic tanks and feedlots. It is known that nitrate levels are elevated above background levels, although nitrate concentrations in at least 95 percent of the wells are still below the public health standard of 10 mg/l. Perhaps 70 wells have nitrate levels of 12-15 mg/l (Brower pers. comm.). The location of the Snake Plain aquifer and groundwater problem areas throughout the state are shown in Figures 2-6 and 2-7. The recharge areas for many groundwater sources are not well known (Levinski pers. comm.).

As seen from the above discussion, stream segments may be considered sensitive or high priority for preservation reasons (presence of hatcheries, sensitive species, high recreational or habitat value); because of governmental priorities or designations (wild and scenic rivers or IDHW high priority areas); or because poor water quality already impacts uses. Permitting activity is expected to be of greater importance in the areas where dairies and feedlots produce the greatest water quality impacts.

In the more pristine areas, although dairies and feedlots do not currently affect water quality to a great extent, effort should be made to retain existing high quality by ensuring that waste facilities for all present and future sources are properly constructed.

Table 2-16 summarizes the sensitive segments by basin, provides the reasons for their sensitive status, and indicates segments suggested for priority under the permit program.

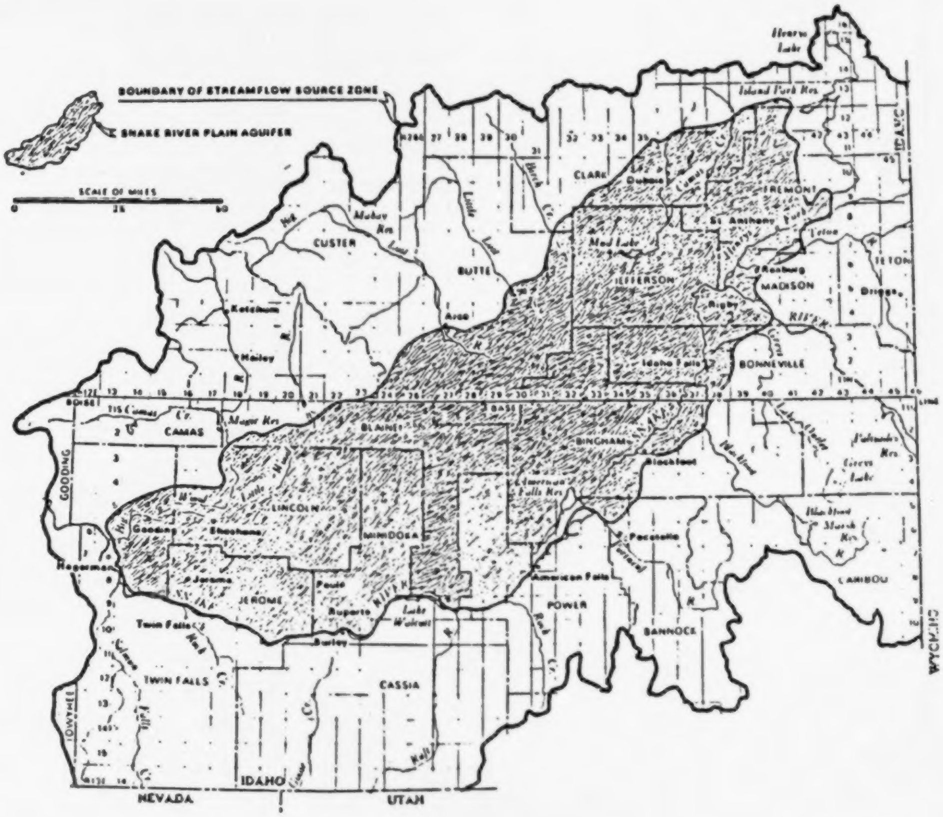
BOUNDARY OF STREAMFLOW SOURCE ZONE
SNAKE RIVER PLAIN AQUIFER
SCALE OF MILES
0
25
50
CUSTER
BUTTE
CLARK
FREMONT
JEFFERSON
MADISON
TETON
BONNEVILLE
BINGHAM
BLAINE
CAMAS
GOODING
LINCOLN
MINIDOKA
JEROME
TWIN FALLS
CASSIA
POWER
BANNOCK
CARIBOU
OWYHEE
Ketchum
Hailey
Arco
Dubois
St Anthony
Rexburg
Rigby
Idaho Falls
Driggs
Mud Lake
Blackfoot
American Falls
Pocatello
Shoshone
Gooding
Hagerman
Jerome
Paul
Rupert
Burley
Twin Falls
Island Park Res.
Henrys Lake
Mackay Res.
Magic Res.
American Falls Res.
Lake Walcott
Grays Lake
Blackfoot Res.
SNAKE RIVER
NEVADA
IDAHO
UTAH
WYOMING

FIGURE 2-6. LOCATION OF THE SNAKE PLAIN AQUIFER

SOURCE: MULLEN PERS. COMM.

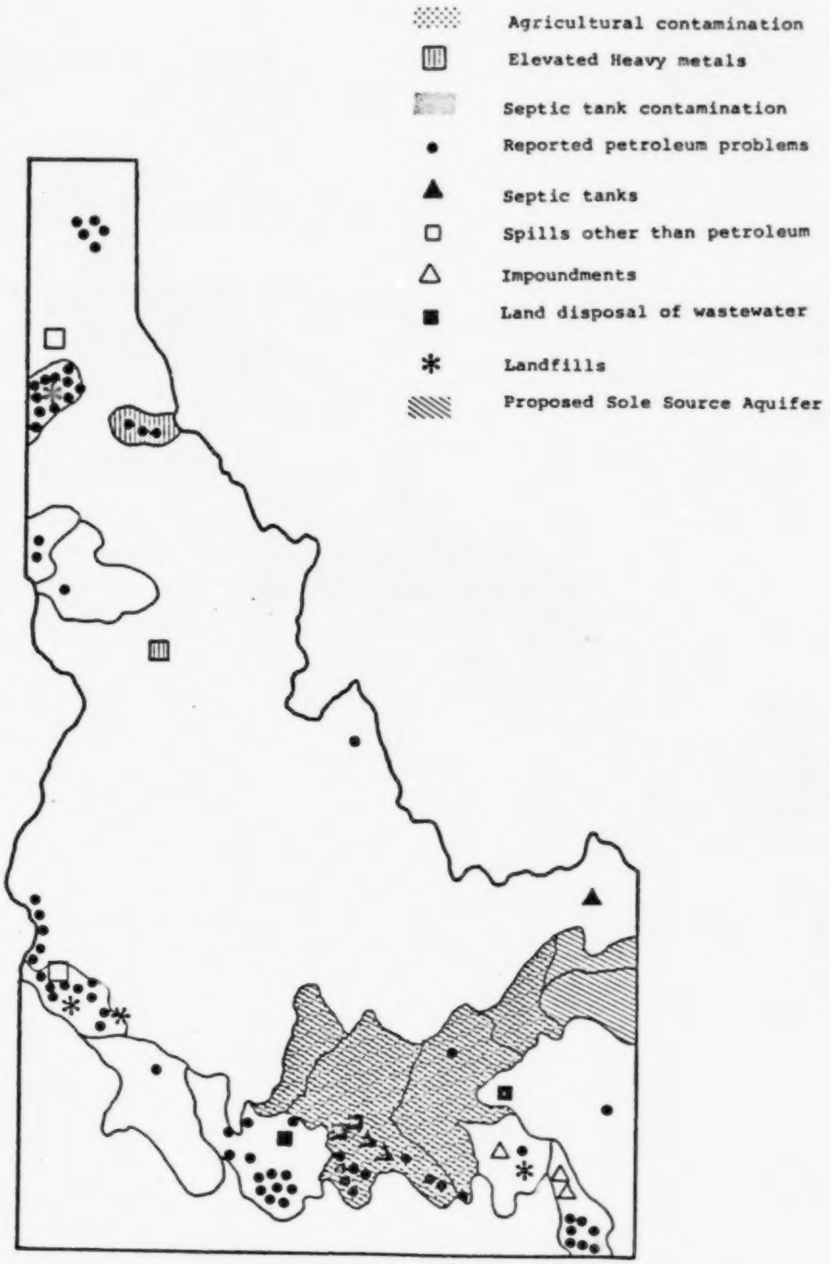
Agricultural contamination
Elevated Heavy metals
Septic tank contamination
Reported petroleum problems
Septic tanks
Spills other than petroleum
Impoundments
Land disposal of wastewater
Landfills
Proposed Sole Source Aquifer

FIGURE 2-7. GROUNDWATER PROBLEM AREAS

SOURCE: ADAPTED FROM IDHW 1984B, SHOOK PERS. COMM.

Table 2-16. Sensitive Stream Segments Summary

SEGMENT	REASONS FOR SENSITIVE STATUS	HIGHEST PERMITTING PRIORITY
Southwest Basin		
Boise R. (SWB 270, 280)	Feedlot/dairy impacts; IDHW priority (270 wastes)	*
Payette R. (SWB 340)	Feedlot/dairy impacts; fish hatchery IDHW priority (wastes)	*
NF and SF Payette (SWB 310, 324)	IDHW priority (wastes)	-
Jordan Cr. (SWB 233)	IDHW priority (habitat & impacts)	-
Snake River (SWB 20)	Feedlot/dairy impacts	*
Upper Snake Basin[1]		
Deep Cr. (USB 810)	Feedlot/dairy impacts; IDHW priority (wastes); hatcheries	*
Big and Little Wood (USB 830, 871)	Feedlot/dairy impacts	*
Rock Cr. (USB 730)	Feedlot/dairy impacts	*
Mud Cr. (USB 800)	Feedlot/dairy impacts	*
Cedar Draw Cr. (USB 740)	Feedlot/dairy impacts; hatcheries; IDHW priority (wastes)	
Billingsley Cr. (USB 840)	Hatcheries; IDHW priority (rec. & habitat value); dairy/feedlot impacts	-
Portneuf R. (USB 410, 420)	IDHW priority (wastes)	-
Riley Cr. (USB 830)	Hatcheries	-
Magic & Is. Park Res. (USB 860, 220)	IDHW priority/rec. and habitat value	-
Bear River Basin		
Bear R. (BB 30, 10)	Feedlot/dairy wastes (30); IDHW priority (10; rec. and wastes)	*
Cub R. (BB 450A, B)	Feedlot/dairy wastes; IDHW priority (450B; rec. & wastes)	*
Bear Lake (BB 120)	IDHW priority (rec., wastes); limited range for several sp. of concern	-
Mink Cr. (BB 410)	Feedlot/dairy wastes	*
Worm Cr. (BB 430)	Feedlot/dairy wastes; IDHW priority (rec. and quality)	*
Little Malad R. (BB 471)	IDHW priority (rec. & wastes)	-
Salmon River Basin		
Rapid R. (SB 611)	Feedlot/dairy concentrations; W/S river; hatcheries	*
Whitebird Cr. (SB 710)	Feedlot/dairy concentrations	*
Rock Cr. (SB 810)	Feedlot/dairy concentrations	*

Table 2-16. Sensitive Stream Segments Summary (continued)

SEGMENT	REASONS FOR SENSITIVE STATUS	HIGHEST PERMITTING PRIORITY
Salmon River Basin (continued)		
Salmon R. (SB 70)	Feedlot/dairy concentrations	*
Blackbird Cr. (SB 421)	IDHW priority (impacts & habitat)	
Panther Cr. (SB 430)	IDHW priority (impacts & habitat)	
Monumental Cr. (SB 441)	IDHW priority (habitat)	
Yankee fork (SB 110)	IDHW priority	
EFSF Salmon R. (SB 511)	IDHW priority (impacts)	
Lemki R. (SB 120)	IDHW priority (impact); hatcheries	
MF Salmon R. (SB 440)	W/S river	
SF Salmon R. (SB 510)	Hatcheries	
Pahsimeroi R. (SB 210)	Hatcheries	
Clearwater Basin		
Lindsay Cr. (CB 210)	Feedlot/dairy wastes	*
Tammany Cr. (CB 110)	Feedlot/dairy wastes	*
Potlatch R. (CB 154)	IDHW priority (habitat)	
Lawyers Cr. (CB 141)	IDHW priority (impacts)	
Big Canyon Cr. (CB 151)	IDHW priority (habitat, threats)	
Lapwai Cr. (CB 156)	IDHW priority (rec., habitat, hatchery)	
Clearwater R. (CB 120, 121, 130)	W/S river	
Snake R. (CB 310)	W/S river	
Panhandle Basin		
SF Coeur d'Alene (PB 130)	Hatcheries	
NF Coeur d'Alene (PB 120s)	Hatcheries	
Kootenai drainage	Species of concern	
St. Joe R. (PB __)	W/S river	
Pend Oreille lake (PB 20p)	IDHW priority (rec., habitat)	
Coeur d'Alene lake (PB 30p)	IDHW priority (rec., habitat)	
Hayden lake (PB 430s)	IDHW priority (rec., habitat)	
Twin lake (PB 420s)	IDHW priority (rec., habitat)	
Priest lake (PB 340p)	IDHW priority (rec., habitat)	

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[1] Unnumbered segments in this basin which are considered sensitive because they are source waters for hatcheries include Cassiz, Slaughterhouse, and Box Canyon Creeks and numerous springs.

Chapter 3

ALTERNATIVE TECHNOLOGIES AVAILABLE TO OWNERS OF CONFINED ANIMAL OPERATIONS

Operational Considerations and Constraints Related to Soils and Climate

Soils normally have an important relationship to quantity and quality of surface water runoff and runoff impact on adjacent water bodies. The soil type is a major factor in determining the degree to which precipitation will infiltrate or shed as stormwater runoff. Infiltration capacity can be particularly important in sizing of impoundments where runoff is to be contained. In animal confinement areas, however, the relationship between infiltration capacity and soil texture or type tends to be obscured by several factors. Animals compact the soil, and animal manure tends to clog soil pores and seal the surface layer, retarding water infiltration. During much of the winter, frozen ground also prevents infiltration of rain (McCollum pers. comm.).

Given the combined effect of these factors on most soils, most of the water falling on a confined animal feeding area during winter is likely to run off. In conditions where rainfall also results in snowmelt, runoff due to the rainfall event may even exceed the measured precipitation. In times of unfrozen or unsaturated ground, soils will play a greater role in reducing runoff absorption, particularly where sandy soils allow more rapid infiltration. Proper facility design requires site-specific knowledge of both surface soils and soil profile because soil type and texture can vary greatly from place to place within a small area.

Proper design and operation of a feedlot and dairy facility also require an understanding of climatic influences. Both single and chronic rainfall events can wash accumulated manure from feedlots and dairy yards and cause overflow of impoundments. Snowmelt, especially combined with a warm spring rain or even average rainfall on frozen ground, often causes manure-laden water to run from feedlots and dairies into streams, canals, or onto adjacent properties.

The various relevant climatic factors affecting facility containment include:

- Rainfall duration, intensity, and cumulative total;

- Presence of frozen ground, accumulated snow, or thawed but saturated soil;

- Temperature, particularly as related to potential for snowmelt or thaw conditions; and

- Evaporation of rain or accumulated snow.

Operational factors specific to the feedlots and dairies that interrelate with these factors include the level of wastes in impoundments, the ability of fields to accept waste deposition, and the routes for surface drainage within the operation.

In Idaho, cumulative precipitation is especially important during winter. Impoundments cannot be pumped out onto fields because manure-laden water cannot percolate into the frozen soil. Temperature data indicate there is a 2-3 month period in Boise and Twin Falls (around December and January) and a 3-4 month period in the Pocatello-Blackfoot area (around December through February) that may be expected to have frozen ground. Normal runoff would total about 4 inches for a 3-month period in Boise, and 4 inches also for a 4-month period in Pocatello.

During this period, some evaporation will occur, particularly where precipitation remains as snow. However, a year with heavy precipitation can deposit a substantial quantity of snow which remains as a progressively-accumulating reservoir of "latent runoff" during the winter. In 1983, for example, a total of 5.63 inches of precipitation fell from January through March at Boise.

Evaporation will reduce the amount of precipitation that accumulates on the ground or is stored in retention ponds. The evaporation rate varies greatly on a seasonal basis. Using an average annual evaporation rate when designing impoundments can produce unrealistic results because most of the evaporation data are for irrigation months, which have high evaporation rates. Winter months, when runoff storage is required, tend to have much lower evaporation rates.

Evaporation rate is determined by the surface area available for liquid or ice crystals to convert to water vapor, as well as by a wide range of climatic factors including temperature, relative humidity, and wind velocity. In winter, rain and melting snow will have less opportunity to infiltrate the soil because of frozen ground. Most water will run off and be collected in an impoundment, where the evaporation will be limited to the relatively small surface area of the pond. If precipitation remains on the corral area as snow, it will sublime from the entire watershed area. Trampling and compaction of snow, and waste deposition by animals, will reduce evaporation to some degree and may also hasten thawing.

Because frozen ground, cumulative precipitation, evaporation, and other climatic factors have such a great effect on runoff and runoff storage, they should be considered when evaluating the function and utility of control and treatment technologies. These factors and their impact on containment pond design are also discussed in greater detail in Jones & Stokes Associates (1985).

Control and Treatment Technology Types

A number of control and treatment technologies are available to the operator of a confined animal feeding operation. These include both in-process and end-of-process technologies. In-process technologies refer to operational and physical aspects of an operation and their associated impacts on waste management. These include feed formulation, water utilization, housekeeping practices, site selection, and production methods. Physical facilities associated with waste collection and storage, such as pen design, cleaning procedures, underfloor manure storage pits, and manure stockpiling, are also considered in-process technologies. In contrast, end-of-process technologies involve the treatment of wastes or contaminated runoff after they leave the operation. In general, end-of-process technologies will have greater impact on receiving water than in-process technologies, and they will also have greater implications in sensitive areas.

Economic Considerations

Economically, two general approaches to waste management are available to feedlot and dairy operators. Manure and contaminated runoff can be collected, treated, and disposed of as waste, or they can be used as a productive resource. By viewing animal wastes as a productive resource, increased costs of storage and handling the waste material can be offset, either partially or entirely, by savings on other production costs such as fertilizer. In addition to its value as fertilizer, manure can be used as a feed supplement or to produce methane gas.

Important factors influencing an operator's decision on which waste management approach to pursue include the operator's planning horizon, the availability and cost of capital, and the type of farming operation. If, for example, a farmer's operation includes only dairy farming and the farmer's planning horizon is short-term (e.g., five years), investment in facilities and equipment required to handle and store animal wastes may not be cost effective because, without crops for land application, the fertilizer value of the manure to the farmer would be limited. Consequently, disposal may represent the operator's best option.

For the profit-minded operator, the waste management decision is based on cost minimization criteria. Some farmers will find collection, storage, and land application of manure economically feasible because of the positive returns associated with its nutrient value. In other cases, the additional capital investment, labor, and management required to use manure as a productive resource will exceed the benefits, and disposal would represent the less costly approach.

To identify the operator's most cost-effective approach, cost data need to be assembled in a format appropriate for analyzing and comparing net costs. A partial budget format in which all costs associated with changes in operation are identified and represented as annual costs, provides an appropriate format. An example of a partial budget format is presented in Table 3-1. This format can be used to analyze the cost implications of selective control and treatment systems. In the following analysis, important cost factors associated with each control and treatment technology are identified to provide a framework to select system components for evaluation.

In-Process Technologies

The main types of better known in-process technologies are discussed below, the process is described, and advantages and disadvantages to farmers are discussed in terms of economic and operational considerations. Applicability in sensitive areas is also discussed, and where appropriate, status and reliability of the process are given.

Site Selection

Description. Because effluent generation (particularly in open-lot operations) is greatly dependent on climate and other environmental factors, EPA (1974) considers site selection to be an in-process control technology for confined animal operations. A good site can make the difference between an operation that is properly and efficiently run and one that causes continual environmental problems and difficulties for the operator. If water pollution is to be controlled economically, adequate consideration must be given to factors affecting waste and runoff control during site selection (Ada/Canyon 1977). Geology, climate, surface, groundwater, and topography are all important considerations.

Groundwater pollution from impoundments is a possibility in areas where subsurface geology is porous or contains cracks and fissures that allow waste percolation. Lava outcrops can be a problem from the groundwater perspective because of the incomplete formation of an impermeable organic mat that may occur in these areas. This allows surface water and wastes to flow through cracks and fissures and contaminate groundwater (Gilmour

Table 3-1. Partial Budget Format for Evaluating Hypothetical Costs and Returns of a Dairy Waste Management System

ITEM	OPTION[a]
	Dollars
Additional capital outlays:	
Settling channel construction	470.00
Storage pond construction	2,100.00
8-in. standpipe	100.00
Subtotal	2,670.00
Salvage value	1,335.00
Fixed investment to be amortized at 12 percent for 7 years	1,335.00
Annual fixed costs:	
Fixed investment x amortization factor (0.2191)	292.50
Annual operating costs[b]:	
Labor at $3.50/hr.	7.00
Fuel at $1/gal. + 15 percent for oil and lubricants	9.20
Total annual operating costs	16.20
Total increase in annual costs	308.70
Return from manure as plant nutrients	219.00
Net change in annual costs	+89.70

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[a] The costs and returns associated with adding a settling channel and collection pond to current facilities.

[b] Costs for scraping settling channel.

SOURCE: USDA 1981.

et al. 1975). Southern Ada and Canyon Counties, areas around Twin Falls, and other localized regions are of concern in this regard. Selecting a site in outcrop areas may result in additional expense to the operator if wastes are to be managed properly. In areas with shallow, usable groundwater and porous soils, pond sealants, pond liners or other measures may be necessary to prevent seepage. These can be quite expensive depending on pond size and the type of measures used.

Population growth is an unpredictable factor that causes potentially serious siting problems in areas such as the Boise River Valley. One of the most important considerations near urbanized areas is the dominant wind direction in relation to nearby population centers. Appropriate distance for siting will depend upon whether the operation is upwind or downwind from the population. While choice of location in relation to urban areas may have little direct relevance to water pollution, which is the main concern of this report, odor and nuisance complaints can cause problems for the owner and his neighbors alike.

Climate also has important effects on facility siting. A change in altitude may have great effects on the amount of time ground remains frozen (thus preventing land application of manure and necessitating retention of greater runoff quantities). The ratio of precipitation falling as rain or snow, the evaporation rate, and other factors also affect impoundment volume. Precipitation falling as snow will remain on the lot surface and provide a larger surface area (and longer time) for evaporation than rainfall, which runs off immediately, collects in a pond, and presents a relatively small surface area for evaporation. Wind direction and degree of wetness both affect the odor impacts of an operation on nearby communities.

Location of surface water, land slope, and surface drainage patterns will determine the impact that runoff from a feedlot or dairy will have on surface water. They will also determine the extent to which an operator should modify his site topography to: 1) prevent adjacent land drainage from becoming contaminated as it flows through his property, and 2) prevent his own runoff from affecting nearby waters. Slope is important to promote proper drainage and prevent standing water. It also affects the speed (and erosive capacity) of runoff water and the direction of flow. Steep slopes should be avoided because they facilitate erosion, make design and construction of catchment basins more difficult, and prevent development of the impermeable organic mat that prevents infiltration of organic matter into the soil (Gilmour et al. 1985). The limit of acceptable slope varies among authorities. Gilmour et al. suggest a 12 percent slope as a maximum. EPA (no date) states that 8 percent is an "absolute maximum." This latter number is perhaps the more realistic.

Land spreading of manure is the major ultimate disposal mechanism. Confinement operations should be located in agricultural areas to facilitate finding suitable areas for manure disposal. The expected growth of residential areas or other major developments should also be considered when selecting a site to avoid future use conflicts and odor, fly, and nuisance complaints.

Established feedlots and dairies cannot easily change sites unless an expansion (or reduction) in operation size is planned. At that time, careful consideration of the specific characteristics of various parts of the property should be made to decide which areas should be chosen for expansion or removed from use.

Established operations can mitigate for undesirable characteristics and improve upon a poorly selected site. For example, grading to achieve a slight slope and/or to fill in low spots will allow open lots to drain and dry quickly. Land can also be graded to divert and direct runoff to containment ponds for treatment and storage. At least a 2 percent slope is recommended for feedlots (EPA 1974).

Water running through open cattleyards, whether as a stream or as sheet drainage from adjacent property, is undesirable. These situations should either be avoided in site selection, or mitigations should be provided by fencing, diverting flow, or shielding streams from cattle impact. Diverting runoff entering from adjacent property will prevent its contamination and reduce the volume of runoff requiring containment, thus lowering lagoon construction costs. Location within a floodplain is also hazardous; potential expense and physical and environmental problems caused by flooding can be significant. A confinement area should be located at least 100 yards (if possible) from a stream, canal, or drainage channel (Ada/Canyon 1977).

The degree to which each of these factors is important is highly site-specific and cannot be generally predicted. This is one reason a farm management plan should be completed for each operation, so that site-specific concerns can be identified and mitigating measures can be adopted.

Impacts on Farmers. The advantage in choosing a good site is obvious. Good on-site drainage, proper slope, and absence of off-site drainage or streamflow through the cattleyard will reduce the need for farmer mitigation measures and thus reduce farmer costs. The degree to which a farm site will require mitigation depends primarily on site-specific factors that are difficult to generalize. For example, shallow soils with underlying lava or bedrock will require shallower impoundments which, in turn, require larger surface area and more land. The amount of grading required to prevent off-site drainage and to direct on-site drainage to a containment pond depends on the degree and direction of the natural land slope. Advantages to having a well-drained and well-chosen site include drier land, healthier cattle, and less chance of environmental violations with the resulting imposition of restrictions or mitigation measures.

The selection of a poorly located site can significantly increase waste management costs for an operator. A poorly located site may require construction of diversion facilities to reduce runoff from adjacent properties or excavation of an impoundment area larger than otherwise needed to store runoff. If shallow soils also are located on the site, an even larger impoundment area would be required, resulting in additional construction costs.

For an operator with space limitations, the need for a larger impoundment may result in less area available for agricultural production, thereby reducing annual revenues. With minimum area requirements of 70-400 ft^2/animal in unpaved feedlots, any significant increase in impoundment area could substantially reduce annual revenues.

As an example, a site is selected for a 3,000-head feedlot operation. If the pond area needed to contain all runoff is estimated at 93,300 ft^2 (approximately 2.14 acres) (see Table 4-1), assuming adequate soil depth, the depth of the pond would be approximately 12 feet. If shallow soils restrict the pond depth to 6 feet, the surface area required for the impoundment would be doubled. Assuming there is no available space for the impoundment other than the cattleyard, and an area requirement of 200 ft^2/head (unpaved lot), the feedlot operation would need to be reduced by approximately 466 head to accommodate the impoundment area. This would represent a 15 percent decrease in production.

Other potential costs associated with improperly located sites include grading and excavation costs estimated at \$1.00/yd^3 to construct ponds and diversions for runoff, and fending costs at \$1.00 to \$1.25 per linear foot to restrict cattle from stream areas (Zollinger pers. comm.).

Application in Sensitive Areas. Because site selection so directly affects water quality, this control technology is very important in sensitive areas, particularly where water quality is presently high and prevention, rather than restoration, is the reason for a sensitive area designation. New operations should be carefully sited to avoid generating runoff or waste discharges. Existing operations should institute mitigations to ensure containment of all waste and runoff and to prevent direct animal contact with streams within or adjacent to the property.

Housekeeping Practices

Description. Housekeeping practices, such as frequency and method of manure removal, can have significant effects on the total wasteload as well as on fly and odor problems. Manure often seals the surface of cattleyards and the bottom of lagoons, preventing water infiltration. Cleaning procedures that leave a thin layer of manure provide a barrier to infiltration and help prevent groundwater contamination. Removal of this layer will improve infiltration and result in cleaner pens, but it will also produce a larger volume of waste, which may increase spreading costs and increase the potential for groundwater pollution. If manure is scraped and stockpiled, storage in areas protected from rainfall and drainage is necessary. This will decrease pollution generated by the manure pile and facilitate its spreading as dry manure.

The interval between corral or pen cleanings can also affect both volume of wastes and cost. Longer intervals between cleanings allow greater biodegradation of wastes to occur. This decreases total waste volume, but increases the solids loading in runoff events. A 6-month cleaning of yard wastes can result in a decrease of 20 percent total solids and can decrease water content from 85 percent to 30 percent (EPA 1974).

The degree and frequency of equipment cleaning and maintenance will affect the amount of water use. It will also offset the indirect loss of water through equipment leakage, particularly from equipment such as continuous overflow waterers.

Impacts on Farmers. Solids separation prior to containment will reduce impoundment volume and decrease both odor and COD of wastes in the pond. Frequent equipment cleaning will disrupt fly life cycles, reducing fly populations. The interval most cost effective for cleaning depends on a number of factors, including waste disposal methods, distance between the generation and waste application site, cost of application equipment, and other factors.

Depending upon the operator's approach to waste management, housekeeping practices will provide a different array of costs and benefits to the operator. For operators whose approach to waste management is disposal, good housekeeping practices such as regular cleaning of livestock areas and equipment can significantly reduce flies and objectionable odors. This not only benefits the operator but, for feedlots and dairies near residences, may reduce the potential for complaints that could lead to more costly mitigation. In addition, regular cleaning and maintenance may reduce treatment costs for certain types of treatment technologies.

For operators who utilize waste material as a resource, good housekeeping practices, such as regular removal of manure, can affect the resource value. As shown in Tables 3-2 and 3-3, solids separation can significantly increase the nutrient value of waste material. The economic returns from utilization of this resource (which are discussed in more detail in the following Land Application section) can offset the additional storage and handling costs associated with good housekeeping practices.

Other potential economic effects relate to water usage and impoundment requirements. Although water usage associated with

Table 3-2. Nitrogen, Phosphate and Potash Available to Crops from Dairy Waste per Animal Unit[a] for Alternative Handling Systems

SYSTEM	NUTRIENTS AVAILABLE TO CROPS PER ANIMAL UNIT[b] (LBS/YR) NITROGEN	PHOSPHATE (P_2O_5)	POTASH (K_2O)
Solid handling, daily spread	124	76	149
Solid handling, uncovered storage surface spread	143	76	141
Solid handling, covered storage, soil incorporated[c]	179	76	149
Solid handling, uncovered storage, soil incorporated[c]	170	76	141
Solid handling, storage in loafing shed, surface spread	107	76	141
Liquid handling, storage, surface spread	116	76	149
Liquid handling, storage, soil incorporated[c]	149	80	158
Liquid, flush, lagoon, irrigate	32	42	100
Liquid, flush, solid separation, lagoon, irrigate	26	34	80
Solid handling, open lot storage, surface spread	76	71	141

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[a] One animal unit = 1400 lb cow.

[b] Average assumed production from 1400 lb cow: 210 lb/yr N, 84 lb/yr P2O5 and 166 lb/yr K2O.

[c] Injected or plowed down the day of spreading.

SOURCE: EPA 1978.

Table 3-3. Nitrogen, Phosphate and Potash Available to Crops from Beef Waste, per Animal Unit[a] for Alternative Handling Systems

SYSTEM	LBS/YEAR AVAILABLE TO CROPS PER ANIMAL UNIT[b] (LBS/YR) NITROGEN	PHOSPHATE (P_2O_5)	POTASH (K_2O)
Feeders (1000 lb)			
Unpaved lot, shelter, solid handling	53	64	80
Paved lot, shelter, solid handling	58	64	80
Unpaved lot, no shelter, solid handling	45	46	64
Total shelter, slotted floor liquid handling	68	82	95
Total shelter, slotted floor liquid handling, injection	88	86	101
Paved lot, shelter, flushing, lagoon, irrigation	19	46	64
Stockers (500 lbs)			
Pastured on winter wheat	23	22	26
Cow-Calf (1250 lbs)			
Pasture year around	98	100	114
Pasture, winter in unpaved lot, solid handling	77	85	100
Pasture, winter in paved lot, shelter, solid handling	80	85	100

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[a] One animal unit: feeder at 1000 lbs, 2 stockers at 500 lbs, cow-calf at 1250 lbs.

[b] Production of nutrients per year (lbs):

	N	P_2O_5	K_2O
1000 lb feeder animal	124	91	106
500 lb stocker	62	45	53
1250 lb cow-calf	131	100	114

SOURCE: EPA 1978.

good housekeeping practices would increase water supply costs and impoundment requirements, these increases are likely to be more than offset by the volume reductions from solids separation.

Application in Sensitive Areas. Housekeeping practices probably have less impact on surrounding areas than other in-process technologies, assuming required control technologies are in place to intercept runoff. If containment structures are marginal (or inadequate), more frequent cleaning will decrease solids content and improve the impoundment's ability to contain the runoff, as well as improving quality of runoff.

Production Methods

Description. Production methods will affect waste quality, type, and volume. Beef cattle production and dairies may use either open lots (paved or unpaved) or housed lots. Housed lots, in turn, may have either slotted or solid floors. While the amount of waste produced per animal will not vary, the amount of other wastes, including bedding, washwater, and runoff volume, will vary greatly depending on the type of facility used.

Open lots provide limited protection for the cattle (and for the ground surface). Because they are uncovered, they generate a volume of contaminated runoff proportional to the surface area of the lot and the condition of the lot surface. Paved lots will prevent water infiltration, resulting in nearly 100 percent runoff of precipitation, but they also allow an equal number of animals to be contained in a smaller yard area, which reduces the total area generating runoff.

Cattle in unpaved feedlots are generally provided 70-400 ft^2/animal; paved lots generally provide more than 90 ft^2/animal (EPA 1974). Because the soil in an unpaved feedlot is compacted and sealed by manure, water infiltration is often poor. In this situation, an unpaved lot may generate more total runoff than an operation of equal animal numbers on a paved lot simply because the difference in infiltration is not sufficient to offset the advantage of the reduced surface area. In 1974, an estimated 96 percent of all beef cattle were in open dirt lots. The number of paved lots was fewer than 1 percent (EPA 1974). This figure has probably changed little in the last decade because paving is expensive.

Housed facilities that keep the animals continually under a roof may have dirt, paved, or slotted floors. Slotted floor structures have either a shallow pit below the floor that is cleaned daily or a deep pit where waste is stored. For liquid cleaning systems, sufficient water is needed to permit dilution of the manure and allow pumping. For semisolid systems, tractor or loader access to the pits must be provided or under-floor alley scrapers can be installed that remove the manure and convey it to external storage areas.

Solid floor structures may use bedding to absorb moisture and keep wastes solidified. Storage for manure is provided by maintaining high ceilings. Sloped floor systems may also be used. In these systems, the floor is sloped toward gutters, slotted floors, or other collection facilities and cattle movement gradually works manure toward the collection area, where it is removed by scraping or flushing (PDER 1975).

Animal densities in housed facilities are quite high, with animals having fewer than 30 ft^2/animal. In 1974, only about 4 percent of the cattle operations were housed, with nearly equal numbers having solid and slotted floors. Of those having slotted floors, the deep pit predominated (EPA 1974). In contrast to feedlots nationwide, approximately 75 percent of dairies restrain their animals to a barn at least part of the time, and the number is greater in cold areas.

Advantages and Disadvantages to Farmers. One advantage of a housed facility is the ability to control or virtually eliminate the generation of contaminated runoff, thus decreasing the volume required for containment. This may be offset to varying degrees, however, by the additional volume of washwater and bedding generated. Use of a housed facility allows a farmer to increase his animal density above that which would otherwise be possible on an open lot. This could be important for operations of limited land area. The costs of such an operation can be very high, and this is likely to offset many of the advantages.

Depending on soil conditions, paved lots may allow a decrease in containment pond volume for a given number of animals because of the increased animal densities which are possible; but paving is expensive, and it is likely to cost more to pave a lot than to construct a somewhat larger containment facility unless land is quite expensive.

Costs of most waste disposal systems for concentrated animal feeding operations of less than 1,000 animal units exhibit economies of scale (EPA 1978). That is, as production increases, per-unit waste disposal costs decrease. This principle can be illustrated by considering two feedlot operations of 100-head and 400-head capacity. Because the investment in equipment, such as manure scrapers, loaders, and spreaders would be nearly equivalent for the two operations, costs per head on the 400-head lot would be smaller than for the 100-head lot. In general, smaller operations will incur a greater cost burden per head for waste disposal systems than larger operations.

In addition to economies of scale, other important production cost factors relate to whether the operation is housed or open and, if open, whether the lot is paved or unpaved. An EPA study (1978) on livestock waste management systems evaluated annual costs of representative systems for different herd sizes and types of operations. The results of this analysis are summarized in Table 3-4.

As shown in Table 3-4, annual costs per head for waste management for the totally housed operation exceed costs for the open operation, whether paved or unpaved lots. Assuming 50 percent usage of nutrients, the annual cost differential between the fully housed and the unpaved, partially sheltered operation is $32.04 per head for the 100-head capacity operation and $20.91 per head for the 700-head capacity operation. Costs for runoff control are not included and all costs are presented in 1978 dollars.

It should be noted that, unlike feedlot operations, dairy operations in general have less potential to return a profit on the waste disposal system because of the higher investment required for waste system facilities (EPA 1978).

Application in Sensitive Areas. As with other in-process technologies, the real impact on surface waters is most dependent upon the end-of-process technology used. If proper disposal facilities are not constructed, the impact of housed facilities on sensitive areas could be worse than that of open lots, as the density of animals would be greater. With proper disposal facilities, whether the operation is open lot or housed, there should be little or no direct impact on water quality.

Water Reuse and Conservation

Description. Volume of water use can have a great impact on waste lagoon sizing. It is considered to be the largest variable in feedlot waste loads, primarily because of the variation in use practices. Many dairies use water to flush wastes from stalls or barns and/or add water to wastes so that they may be pumped to storage tanks or lagoons and reduce handling. Water reuse will reduce the storage volume needed. As climatic characteristics in Idaho normally require storage of 4 months or more, water reduction or reuse could substantially decrease required containment volume. As reuse requires installation of additional equipment, where water is abundant and cheap, it may not be economical to practice this. For some confined animal operations, particularly swine and poultry, the possibility of spreading disease through reuse of water has been a concern, although experiments have not substantiated this (EPA 1974).

Impacts on Farmers. One primary advantage of water reduction is the need for a smaller waste containment pond because less water will be generated. Waste flushing is practiced primarily by dairies; feedlot owners will have little opportunity to practice reuse, although water conservation through repair of leaking watering equipment or other measures can be used to reduce water volumes.

Table 3-4. Comparison of Annual Costs and Returns for Alternative Waste Management Systems for Cattle Feedlots (1978 dollars)

WASTE MANAGEMENT SYSTEM/ HERD SIZE	RETURNS TO NUTRIENTS 50% USAGE AVAILABLE NUTRIENTS (1)	RETURNS TO NUTRIENTS 100% USAGE OF AVAILABLE NUTRIENTS (2)	VARIABLE COSTS (3)	FIXED COSTS (4)	NET SYSTEM RETURNS AT 50% USAGE OF NUTRIENTS (1)-(3)-(4)	NET SYSTEM RETURNS AT 100% USAGE OF NUTRIENTS (2)-(3)-(4)
	(Dollars per Animal Year)					
Dry lot, partial shelter, paved, solid spread[1]						
- 100 head	14.40	28.80	4.93	16.94	-7.47	6.93
- 400 head	14.40	28.80	4.32	9.29	0.78	15.18
- 700 head	14.40	28.80	4.85	8.48	1.07	15.47
Dry lot, partial shelter, unpaved, solid spread[2]						
- 100 head	14.00	28.00	3.14	11.12	-0.25	13.75
- 400 head	14.00	28.00	2.53	5.85	5.62	19.62
- 700 head	14.00	28.00	2.57	5.15	6.28	18.53
Total shelter, fully slotted, liquid spread, 90-day storage[1]						
- 100 head	17.57	35.14	10.14	39.72	-32.29	-14.72
- 400 head	17.57	35.14	9.91	22.59	-14.93	2.64
- 700 head	17.57	35.14	11.40	20.80	-14.63	2.94

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[1] Representative design for cold humid and cool humid climatic regions.

[2] Representative design for cold humid, cool humid, cool arid, and cold arid climatic regions.

SOURCE: EPA 1978.

The amount of water use has the greatest immediate effect on pond sizing; a larger pond is required as the wastewater volume is increased, and larger ponds are more expensive.

Because of sanitation requirements, the potential for water use reduction through conservation is limited in dairies. One dairy process in which appreciable reductions in water usage may be achieved is livestock washing. Based on a recent study by the Midwest Plans Service (1985), water requirements to wash livestock average 1-4.5 gallons per washing per cow. Assuming twice daily washings, a 400-head dairy farm would use between 800-3,600 gallons of washwater daily.

If it is assumed that the lower rate represents the minimum amount achievable through conservation, an operator currently using the maximum rate could reduce daily water consumption by 2,800 gallons. Assuming 100 percent runoff from the cow washing area, this decrease in water usage would reduce the excavation requirements for the impoundment area by an estimated 1,677 yd^3. At an assumed cost of $1.00/$yd^3$, the savings in excavation costs would be approximately $1,700.

Application in Sensitive Areas. The most direct benefits of this practice are economic benefits resulting from reduced containment volume. As long as a containment pond is properly sized, use of this technology will have little effect on sensitive areas.

End of Process Technologies

In contrast to in-process technologies, end-of-process technologies involve the treatment of wastes or contaminated runoff after they leave the operation. These include such practices and technologies as composting, land application, and runoff control, as well as activated sludge, oxidation pits, settling basins, and lagoons.

The EPA (1974) divides end-of-process technologies into categories of complete treatment (i.e., producing a product either capable of entire reuse on the feedlot or one that is readily marketable) and partial treatment (i.e., producing residue, waste, or polluted water that is neither readily marketable nor completely usable on-site). Descriptions of the following technologies are taken in large part from this document.

A large number of end-of-process technologies for manure and runoff are shown in Table 3-5. The great majority of these are still experimental and will not be discussed further. Land application, dehydration, and composting are the primary non-experimental, complete treatment options for manure; oxidation ditches and activated sludge are partial treatment options that will require additional treatment of some type. Runoff

Table 3-5. End-of-Process Technology Classification

	APPLICATION		FUNCTION			STATUS		
TECHNOLOGY	MANURE	RUNOFF	CONTAINMENT	COMPLETE TREATMENT	PARTIAL TREATMENT	BPT	BAT	EXPERIMENTAL
Land Utilization	x	x		x		x		
Compost and Sell	x			x		x		
Dehydration (Sell or Feed)	x			x		x (Sell)	x (Feed)	
Conversion to Industrial Products	x			x				x
Aerobic SCP Production	x			x				x
Aerobic Yeast Production	x			x				x
Anaerobic SCP Production	x			x				x
Feed Recycle	x			x				x
Oxidation Ditch (Spread or Feed)	x				x	x (Spread)	x (Feed)	
Activated Sludge	x				x		x	
Wastelage	x				x		x	
Anaerobic Fuel Gas	x				x			x
Fly Larvae Production	x				x			x
Biochemical Recycle	x				x			x
Conversion to Oil	x				x			x
Gasification	x				x			x
Pyrolysis	x				x			x
Incineration	x				x			x
Hydrolysis	x				x			x
Chemical Extraction	x				x			x
Runoff Control		x	x			x		
Barriered Landscape System		x		x				x
Lagoons for Treatment		x	x		x	x		
Evaporation		x	x		x	x		
Trickling Filters		x			x			x
Spray Runoff		x			x			x
Rotating Biological Contactor		x			x			x
Water Hyacinths		x			x			x
Algae		x			x			x

SOURCE: EPA 1974.

containment and lagoons are nonexperimental, partial treatment options for runoff. Land utilization is the only complete treatment option for runoff.

Runoff Control

Description. There are many options for handling, treatment, and disposal of runoff-carried wastes as shown in Figure 3-1. Because this is an incomplete treatment process, however, additional disposal procedures are necessary. System components include the drainage system, collection and transport drains, the containment area, and an ultimate disposal method (probably land disposal). In some cases, solids separation or settling equipment may also be included. Proper impoundment functioning also requires routine maintenance, including pumping at appropriate times when capacity is reached.

Land contouring to direct flow and diversion of uncontaminated roof runoff are both potential ways of controlling on-site runoff. The degree to which these control efforts are required will vary greatly depending on site-specific characteristics.

The need for construction of facilities to divert and direct on-site runoff to containment facilities can be minimized or precluded by proper site selection, but diversion may be required to prevent off-site runoff from entering the site and becoming contaminated. Berms, ditches, or other structures may be constructed to divert runoff around the property. This will decrease the size of required runoff containment facilities and correspondingly decrease costs and land area required for containment structures. Quality and quantity of runoff will vary greatly depending on the amount of precipitation and solids, type and age of the animals, type of housing, and other factors. A number of factors influence these conditions, including animal density, topography, soils, climate, rainfall duration and frequency, and lot size.

For Idaho, where frozen ground requires waste containment for several months during the winter, runoff retention for a 1-in-5 year winter plus a 25-year, 24-hour storm has been determined necessary to contain runoff and prevent discharge of impoundments. Given local rainfall conditions for a 4-month winter holding period and adjusting for evaporation in the Boise area, this is equivalent to containing a net runoff of approximately 4 inches (Jones & Stokes Associates 1985). This amount will vary slightly, depending on location.

Size and volume of the impoundment will vary, depending on the area to be drained and subsurface site characteristics. In areas near Twin Falls, for example, an underlying lava formation limits impoundment depth to about 4 feet. In these situations, surface area of the impoundment must be increased to meet volume

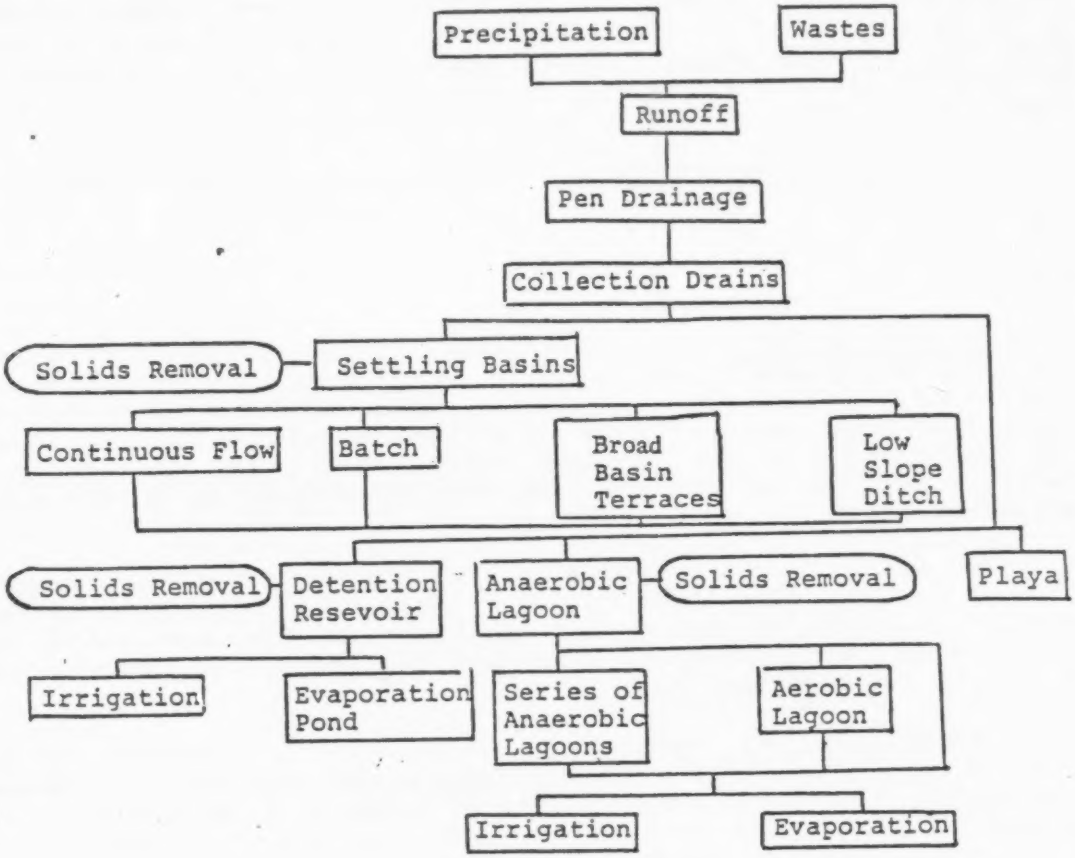

Precipitation
Wastes
Runoff
Pen Drainage
Collection Drains
Solids Removal
Settling Basins
Continuous Flow
Batch
Broad Basin Terraces
Low Slope Ditch
Solids Removal
Detention Resevoir
Anaerobic Lagoon
Solids Removal
Playa
Irrigation
Evaporation Pond
Series of Anaerobic Lagoons
Aerobic Lagoon
Irrigation
Evaporation

FIGURE 3-1. ALTERNATIVES FOR HANDLING, TREATMENT, AND DISPOSAL OF RUNOFF-CARRIED WASTES.

SOURCE: EPA 1974.

requirements. The actual volume required will vary with site-specific conditions, but an approximate idea of the volume can be obtained for visualization purposes. The aerial survey data indicate the average dairy in southern Idaho to be approximately 6 acres. Containment of 4 inches of net runoff over 6 acres would require a storage volume of approximately 651,000 gallons or 91,000 ft^3. This could be contained by an impoundment roughly 95 ft x 95 ft x 10 ft deep (approximately 0.25 acre in surface area at this depth). Additional volume would be required to contain process waste. A 4-foot depth would require a surface area of about 150 ft x 150 ft, or slightly over 0.5 acre.

Status and Reliability. Runoff control mechanisms are fairly simple and easily constructed. Technology is also flexible enough to be used in a wide variety of situations. Its reliability is well established and design data are readily available.

Impacts on Farmers. Controlling runoff from adjacent lands has many advantages, particularly in decreasing the volume of containment facilities. This not only reduces construction costs but also requires less land and reduces spreading costs and time. Controlling on-site runoff will help the feedlot remain drier and may prevent some erosion, depending on the site characteristics.

The major cost for runoff control derives from construction of the holding pond (EPA 1974). Costs to construct dikes, berms, diversion ditches, and settling basins are small by comparison. As previously reported, current (1985) excavating costs are estimated at \$1.00/yd^3.

Runoff control options may consist of either grass infiltration systems or detention/irrigation systems. Of these two types, the detention/irrigation system is generally more costly to the farmer (EPA 1978). The cost disadvantage of the detention/irrigation system is more evident for the small operator because of economies of scale associated with these systems.

Although the cost impact will vary from site to site, annual runoff control system costs for different representative dairy and cattle operations are presented for comparative purposes in Table 3-6. As shown, estimated fixed costs for detention/irrigation systems, however, are higher only for dairy operations. Significant economies of scale also are evident from the data in Table 3-6.

Application for Sensitive Areas. Because of its flexibility, this technology is easily made applicable to sensitive areas. In areas of porous soils where groundwater contamination is a concern, a clay or manufactured liner, although costly, can be added to the impoundment to prevent seepage. The size of the impoundment can be adjusted to meet additional needs if

Table 3-6. Comparison of Annual Fixed and Variable Costs of Alternative Runoff Control Systems (1985 dollars[a])

	RUNOFF CONTROL SYSTEMS					
	BASE WASTE MANAGEMENT SYSTEM		DETENTION/IRRIGATION		GRASS INFILTRATION	
OPERATION/CAPACITY	FIXED	VARIABLE	FIXED	VARIABLE	FIXED	VARIABLE
Dairy[b]						
- 50-head capacity	53.41	79.52	19.29	2.93	2.66	.72
- 100-head capacity	42.64	69.88	11.66	1.84	2.09	.53
- 200-head capacity	31.41	49.18	8.05	1.94	3.03	.26
Cattle[c]						
- 100-head capacity	18.28	5.15	12.45	1.20	2.45	1.20
- 400-head capacity	9.62	4.15	3.58	.97	.67	.97
- 700-head capacity	8.47	4.21	2.80	1.58	.62	1.58

---

[a] All original cost data adjusted to 1985 dollars by the Nationwide Consumer Price Index.

[b] Free stall open lot with tractor scrape, and daily surface spread.

[c] Dry unpaved lot with partial shelter and solids spread.

SOURCE: EPA 1978.

expansion of animals or space is desired. Because maintenance is critical to proper functioning of runoff control systems, a management plan specifying pumping dates and ultimate disposal methods is important, particularly in sensitive areas; operators must monitor their systems to ensure that overflow does not occur. Eliminating off-site runoff will also help prevent overflow of containment facilities, which are normally not sized to contain off-site runoff.

Composting

Description. Composting is considered a complete treatment technology that allows decomposition of organic wastes, such as manure and bedding, and produces carbon dioxide, ammonia, water vapor, and humus, which is usable as a soil conditioner. A number of definitions for composting exist, depending on the viewpoint of the observer. In biologic terms, Toth and Gold (1971) define it as "the process involving conversion of organic residues into lignoprotein complexes (humus) via thermophilic organisms under optimum moisture and aeration conditions." Because it is accomplished primarily by aerobic microorganisms, the process is slow and incomplete without sufficient aeration.

Manure can be composted in several ways. Aerated compost and turned-compost windrows are two commonly used methods. Manure, bedding, woodchips, and similar material scraped from pens or solids settling areas are spread in 3- to 4-foot-high windrows or placed in tanks and bins. The material is periodically aerated by mechanically turning the windrow or pumping air through the tank. During decomposition, temperatures may reach up to 175°F. As a large amount of heat is generated, the pile will dry out and decomposition will cease if adequate moisture is not maintained. A moisture content of 40-60 percent should be maintained during the process to prevent formation of anaerobic conditions (leading to odors) and to maintain normal processing times. Rainfall in uncovered operations may make process control more difficult and leach soluble constituents from the pile. Windrowing requires approximately 30 days; forced aeration in tanks allows process completion in 7-14 days.

Status and Reliability. Commercial composting technology has been in use for a number of years. Aeration is a more recent development, but it has also been demonstrated to function well. The system is simple and reliable if handled properly, although finding an adequate market for the product can be difficult in some areas.

Impacts on Farmers. Composting of manure requires solids separation. Many dairies already practice waste separation, and this would require little change in their existing procedures. Removal of solids will decrease the volume and increase the quality of waste entering the treatment facility. Size of the containment pond can be reduced if solids are removed, thus somewhat reducing construction costs and land area required for the containment pond. It may also thin wastes sufficiently to allow spray application. Production of compost will not reduce the need to dispose of liquid waste and runoff. It will also require a recipient who can make use of the compost. If present wastes are already disposed of via pumping and spreading as a slurry, composting, although it will reduce waste volume, may merely add one more step for the farmer.

Solids separation for composting at dairy and feedlot operations typically requires a front-end loader. For a 400-head feedlot, the capital investment for a front-end loader is estimated at $4,440, based on adjusted cost figures from an EPA study (1978). On an annual basis, the amortized cost per animal would be approximately $3.30. Composting also requires additional labor to maintain proper conditions of the compost pile; the amount of labor is dependent upon the type of process used.

By separating solids for composting, the size of the runoff containment pond for a 400-head feedlot, for example, could be reduced by an estimated 1,419 yd^3, thereby resulting in a savings of about $1,400 in excavation costs. This calculation is based on an assumed daily manure generation rate of 0.6 ft^3, 80 percent runoff reduction, excavation requirements of 32 percent greater than volume requirements, and excavation costs of $1.00/yd^3.

The principal use of the composted product is as a soil amendment. The current market value of soil aids sold in bulk in the Boise area is approximately $14/yd^3 (Hillside Nurseries pers. comm.). For a farmer to realize returns from the composted product, demand for the product, either on site or locally (to minimize handling costs), would be required.

Application in Sensitive Areas. Both runoff and odors are potential problems associated with composting. If composted properly, odors should not be a problem. If windrows are exposed to rainfall, runoff similar in composition to cattleyard runoff will be produced. This can result in quality problems for adjacent waterways and streams. In sensitive areas, runoff from compost windrows should be carefully controlled or composting limited to aerated methods in bins where water can be more closely controlled. Concerns related to land application of compost are discussed under the Land Application section.

Activated Sludge

Description. Activated sludge is considered a partial treatment technology for manure wastes, so an ultimate disposal process will be needed. The process is generally defined as bacterial digestion that occurs in an aerated tank. The process components vary depending on local needs, ranging from a simple, single tank and floating aerator, plus evaporation pond, to more complex processes, such as those used in municipal treatment. These may contain mixed-liquor tanks, clarifiers, flotation tanks, chlorination tanks, and sludge drying beds. A more complex, complete system is shown in Figure 3-2. Sludge and effluent may be land applied. An example of the reduction in BOD, COD, nitrogen, and other parameters for a 100-animal dairy operation is given in Table 3-7. While site-specific variation in each operation will occur, this provides a general indication of what is to be expected from some types of activated sludge systems.

Status and Reliability. Because the activated sludge process can be somewhat complex, plant malfunctions can be relatively frequent in animal-waste processing. The process provides treatment in all weather conditions, and variations have been used for treatment of both feedlot runoff and dairy operations.

Impacts on Farmers. The advantages of an activated sludge system include great reduction in BOD and other pollutants in the wastewater, as well as a reduced need for land application. The primary disadvantages are the cost and the need for some continual oversight to spot potential problems and avoid system upsets.

As indicated in Table 3-8, the capital investment required for activated sludge systems is high. Because this technology clearly exhibits economies of scale, investment in these systems is likely to be cost effective only for large-scale operations. Other conditions, e.g., significant space limitations, accessibility of capital, and high premium on environmental benefits would also need to exist for a farmer to select this treatment technology based on cost minimization criteria.

Because activated sludge systems typically provide more advanced treatment of waste materials, the value of the resulting sludge product is limited. The product will have minimal nutrient value and may exhibit less of the desirable soil amending properties (e.g., filtering and water retention) than are associated with composted products.

Application in Sensitive Areas. The main drawback to use of this process may be the possibility for plant malfunction that would lead to discharge of poorly treated wastes to local rivers or canals. Should this occur, however, the discharge quality is still likely to be better than that of untreated wastes.

Oxidation Ditch (Aeration Ditch or Pasveer Ditch)

Description. The oxidation ditch is essentially a modified form of the activated sludge process. It is an aerobic waste

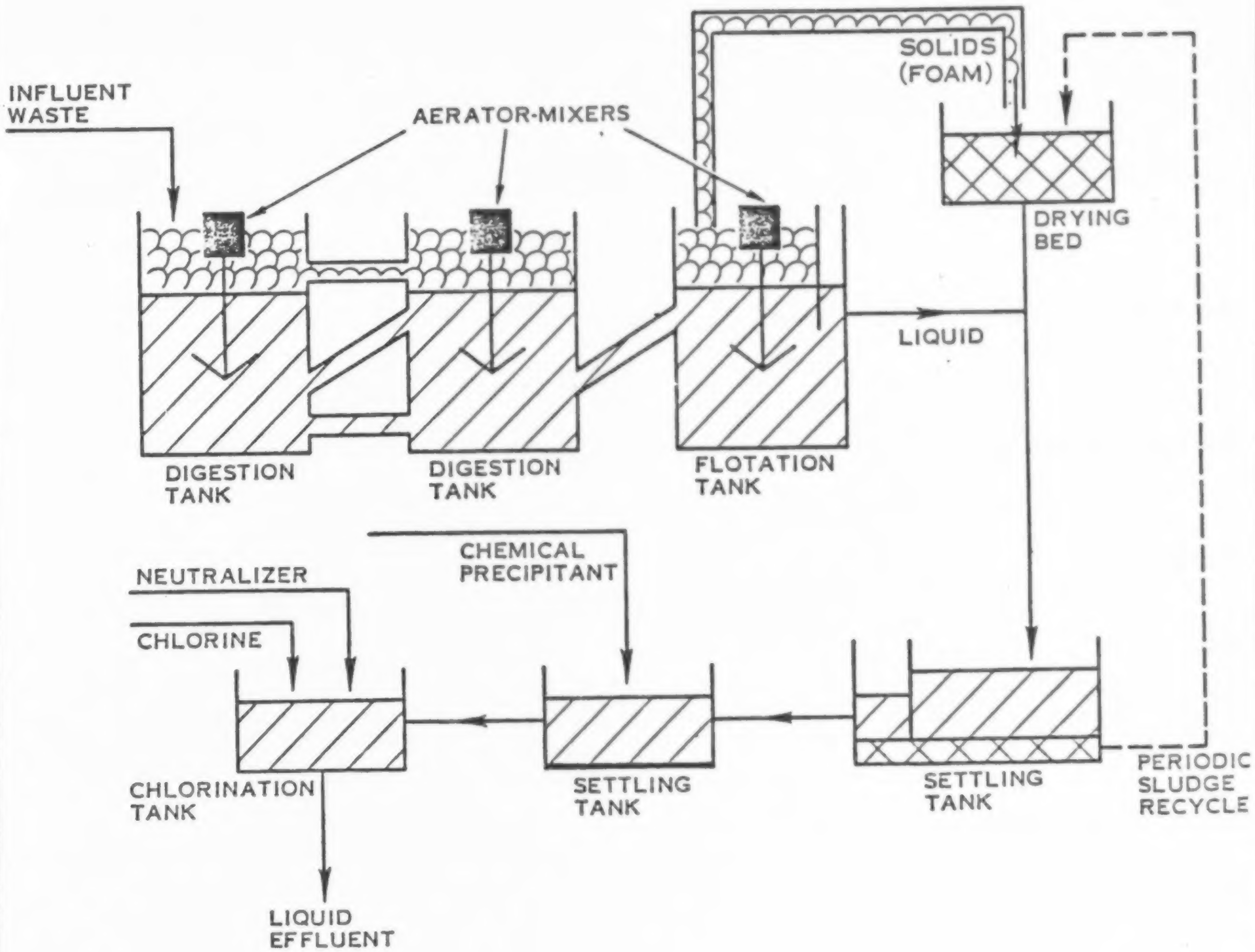

INFLUENT WASTE
AERATOR-MIXERS
SOLIDS (FOAM)
DRYING BED
LIQUID
DIGESTION TANK
DIGESTION TANK
FLOTATION TANK
CHEMICAL PRECIPITANT
NEUTRALIZER
CHLORINE
CHLORINATION TANK
SETTLING TANK
SETTLING TANK
PERIODIC SLUDGE RECYCLE
LIQUID EFFLUENT

FIGURE 3-2. GENERALIZED DIAGRAM OF A MODERATELY COMPLEX ACTIVATED SLUDGE TREATMENT PROCESS

SOURCE: EPA 1974.

Table 3-7. Mass Balance Information for a 100-Cow Dairy Operation Using Aerated Thermophilic Digestion and Flotation

	INPUT		OUTPUT	
WASTE COMPONENT OR SOURCE	L/DAY (GAL/DAY)	KG/DAY (LB/DAY)	L/DAY (GAL/DAY)	KG/DAY (LB/DAY)
Milkhouse	2,540 (670)	2,550 (5,620)	--	--
Manure	4,540	4,585	--	--
Liquid	(1,200)	(10,100)	3,140 (830)	3,170 (6,980)
Fibrous Matter	--	--	300 (80)	300 (670)
Total	7,080 (1,870)	7,135 (15,720)	3,440 (910)	3,470 (7,650)
BOD	--	98 (215)	--	5.2 (11.5)
COD	--	128 (281)	-- --	10.6 (23.3)
Organic Nitrogen	--	9 (20)		2.7 (6)

SOURCE: EPA 1974.

Table 3-8. Relative Cost Factors and Benefits of Alternative Treatment Technologies

TREATMENT METHOD	LAND REQUIREMENTS	CAPITAL INVESTMENT	LABOR REQUIREMENTS	ENERGY COSTS	POTENTIAL PRODUCT RETURNS	POTENTIAL WATER QUALITY BENEFITS
Activated Sludge	low	high	low	high	low	high
Oxidation Ditch	low/mod.	mod/high	low	high	low	high
Waste Lagoons						
- Aerobic	high	mod/high	moderate	high	low	moderate
- Anaerobic	mod/high	moderate	moderate	low	low	moderate

treatment system with extended aeration. For a given situation, an oxidation ditch will normally require more land than an aerated lagoon because it is shallower. This would not necessarily be the case in areas underlain by shallow lava layers, as in the Twin Falls vicinity, where these layers often limit lagoon depth to 3-4 feet.

Because it is considered a partial treatment process, an ultimate disposal process will be required for effluent from oxidation ditches. The oxidation ditch has an elongated shape with a central partition to direct waste flow in a continuous open channel. An aeration rotor at the surface circulates ditch contents and supplies oxygen (Figure 3-3A). Other components may be added as shown in Figure 3-3B. Velocities in the ditch should be maintained at 1-1.5 ft/sec to minimize solids settling. The area for an oxidation ditch is only 5-10 percent of that needed for an oxidation pond (Loehr 1971). Aerobic bacteria are used to degrade the organic materials to carbon dioxide and water as the main products. BOD reductions of 80-90 percent have been obtained (Loehr 1971).

Oxidation ditches may be in-house or external ditches. The in-house ditches are located beneath slotted floor facilities and "take advantage of the continuous and uniform waste loading to the unit, the controlled temperature in the confinement building, and the continual mixing and aeration to produce a near-ideal biological waste treatment process" (Loehr 1971). In these situations, the amount of water volume used to flush the wastes can be reduced, resulting in a smaller treatment system. The external ditch is separate from the waste production site, uncovered, shallow, and exposed to ambient temperatures.

For oxidation ditches with continuous overflow, an aerated lagoon (to prevent odors) can be installed to accept wastes prior to final discharge or treatment. This discharge can be integrated with crop management.

Status and Reliability. This waste system is one of the easiest and simplest to maintain. Start-up is the most critical time; up to 12 weeks are reported necessary for a ditch to acclimatize to the loading. Oxidation rates also drop considerably as freezing is approached. Because wastes are pumped in, they may be added intermittently. Loehr (1971) reports "shock loading" may cause foaming and inefficiency. In contrast, EPA (1974) states that the systems are "reliably insensitive to batch loading." Foaming (particularly at start-up), humidity (in confined areas), odors, and rotor maintenance are all potential problems; but generally, this approach is considered low in odors, low in manual labor, and convenient for the operators (EPA 1974). Prolonged power outages could disrupt the system.

Impacts on Farmers. Although effluent from this system would still require disposal, this system would provide improved

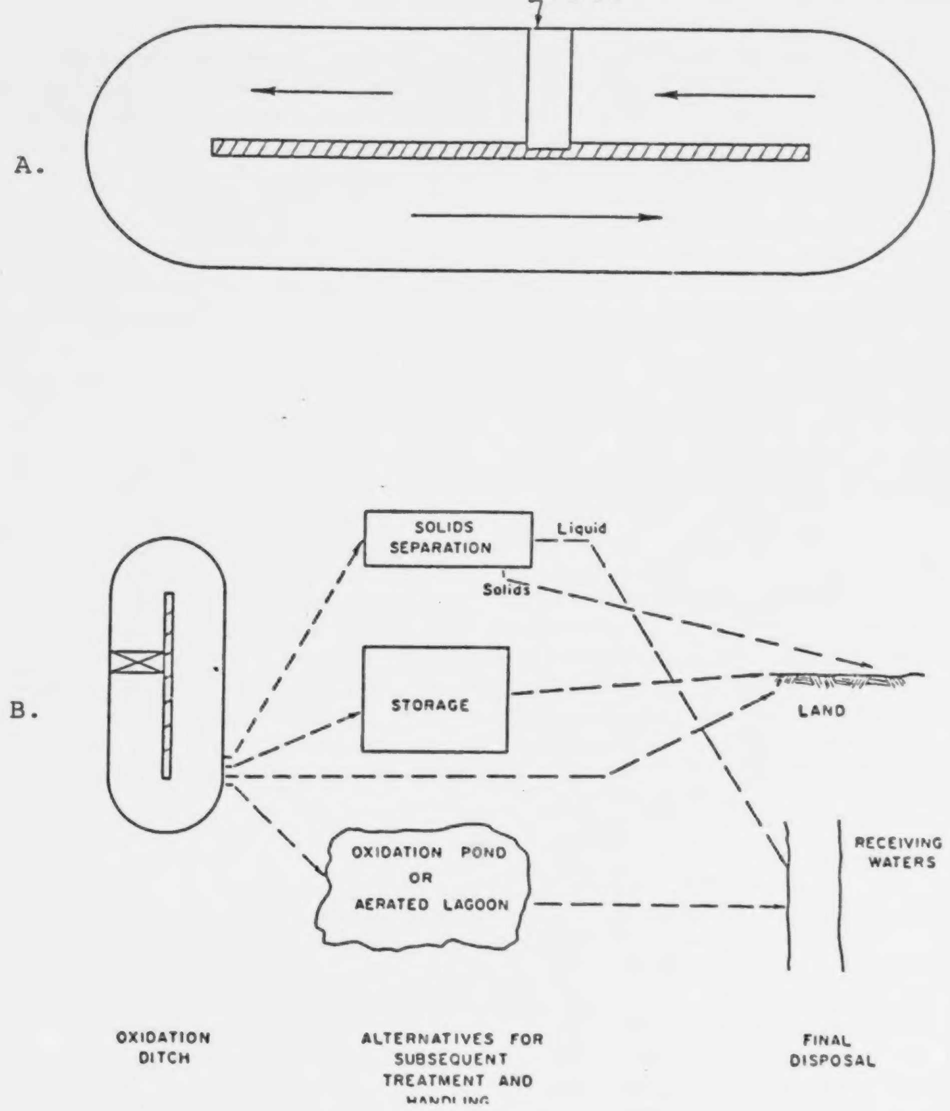

ROTOR
A.
SOLIDS SEPARATION
Liquid
Solids
STORAGE
LAND
B.
RECEIVING WATERS
OXIDATION POND OR AERATED LAGOON
OXIDATION DITCH
ALTERNATIVES FOR SUBSEQUENT TREATMENT AND HANDLING
FINAL DISPOSAL

FIGURE 3-3. DIAGRAM OF A BASIC OXIDATION DITCH (A) AND INTEGRATION WITH ADDITIONAL TREATMENT AND DISPOSAL ALTERNATIVES (B)

SOURCE: LOEHR 1971.

effluent quality, and would require minimal farmer maintenance. It has a relatively high initial construction cost and continuing electrical costs (Taylor 1970).

Similar to activated sludge systems, capital investment in the oxidation ditches is relatively high with high on-going energy costs (Table 3-8). The land requirements for oxidation ditches are likely to be moderate, which could affect production and revenue generation potential of operations with space limitations.

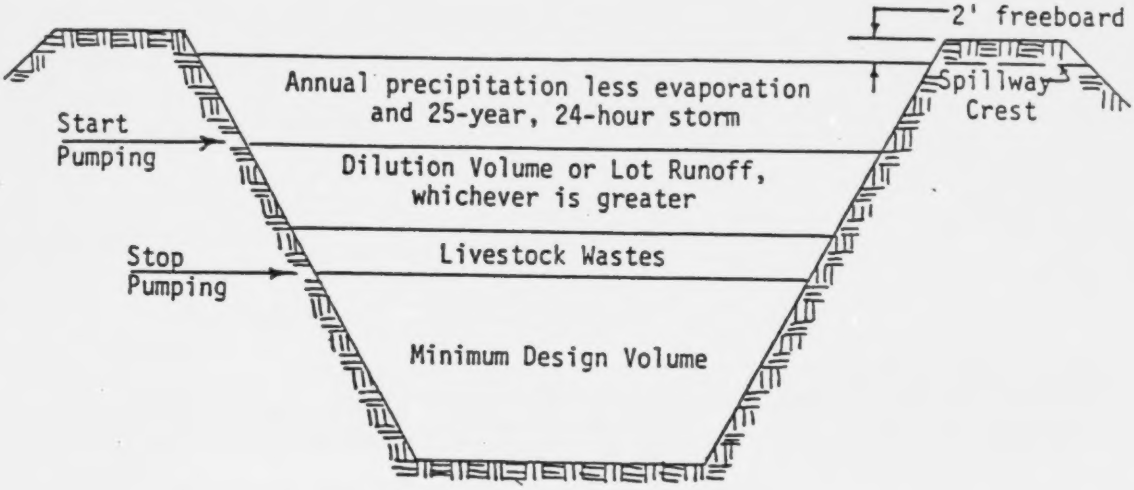
Potential environmental benefits from oxidation ditch treatment systems are high because of good effluent quality. The value of the sludge product periodically removed from the ditch, however, would be minimal. The relatively low labor requirements to maintain the system will offset, to some extent, the reduced savings on product return.

Application to Sensitive Areas. This method produces effluent with BOD reductions of 80-90 percent. While the product still requires disposal, any runoff resulting from land application of sludge would be of much higher quality, thus reducing impacts. This method would also be useful in areas where groundwater contamination is a concern. The land area required is somewhat larger than would be necessary for a normal retention pond; but in locations where lava beds lie close to the surface, normal retention ponds must have a large surface area anyhow because their depth is often restricted. These areas are also prone to groundwater contamination; thus, both surface and groundwater might benefit from such a system.

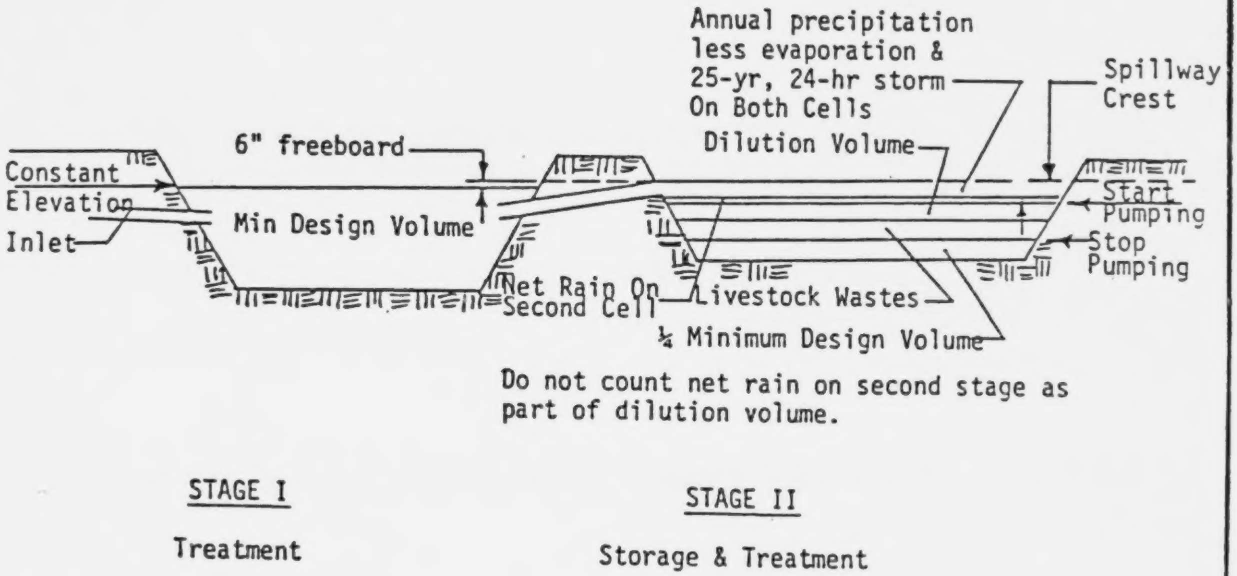
Waste Lagoons

Description. Lagoons are considered a partial treatment process. Waste lagoons are excavated ponds that provide biological treatment for wastewater and/or manure. Often they may be used in conjunction with a settling basin that removes solids before effluent enters the lagoon. This will extend life of the lagoon between cleanouts, and make solids removal easier because the basin can be designed to facilitate cleanout. For maximum decomposition to occur in a lagoon, animal waste needs to be diluted with 6-10 times its volume of water (Taylor 1970). Lagoons are in common use and may be naturally aerated, aerobic, or anaerobic. Generalized diagrams of anaerobic and aerobic waste lagoons are shown in Figures 3-4 and 3-5.

Naturally aerated ponds (oxidation ponds) are shallow, with sizing based on surface area and BOD, because oxidation occurs only in the upper 18 inches of the pond. Oxidation ponds support algae and bacteria, and climatic conditions must favor algae growth and introduction of oxygen. These ponds require light, warmth, and wind for optimum functioning. Bacteria in the pond decompose the wastes and use oxygen provided by the


2' freeboard
Annual precipitation less evaporation and 25-year, 24-hour storm
Spillway Crest
Start Pumping
Dilution Volume or Lot Runoff, whichever is greater
Livestock Wastes
Stop Pumping
Minimum Design Volume

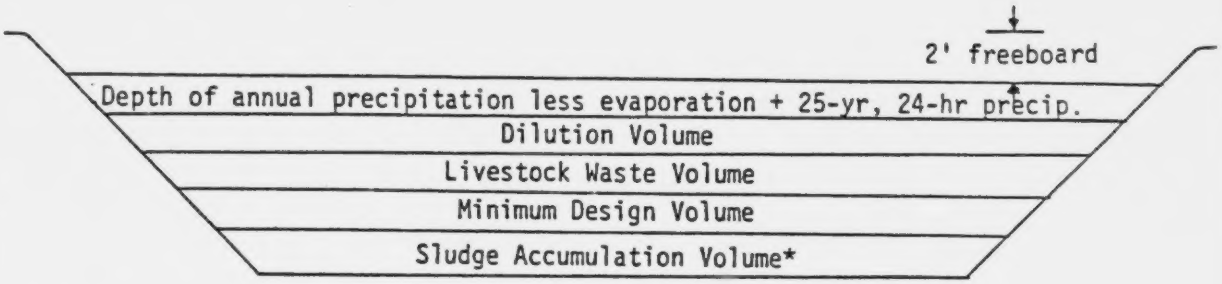
Single Cell - Anaerobic Lagoon


Annual precipitation less evaporation & 25-yr, 24-hr storm On Both Cells
Spillway Crest
6" freeboard
Dilution Volume
Constant Elevation
Inlet
Min Design Volume
Start Pumping
Stop Pumping
Net Rain On Second Cell
Livestock Wastes
½ Minimum Design Volume
Do not count net rain on second stage as part of dilution volume.
STAGE I
Treatment
STAGE II
Storage & Treatment

Twin Cell - Anaerobic Lagoon

FIGURE 3-4. GENERALIZED DIAGRAM OF SINGLE- AND TWIN-CELL ANAEROBIC LAGOON SYSTEM

SOURCE: ODA 1982.


2' freeboard
Depth of annual precipitation less evaporation + 25-yr, 24-hr precip.
Dilution Volume
Livestock Waste Volume
Minimum Design Volume
Sludge Accumulation Volume*

*THE VOLUME OF LONG-TERM SLUDGE ACCUMULATION TO EXPECT CAN BE ESTIMATED ON THE BASIS OF 1 FT^3 OF SLUDGE FOR EACH 20 TO 30 LBS OF VOLATILE SOLIDS.

FIGURE 3-5. GENERALIZED DIAGRAM OF AN AEROBIC LAGOON SYSTEM

SOURCE: ODA 1982.

algae. The algae, in turn, use carbon dioxide and products of the bacterial waste metabolism. Because of their shallow depth, oxidation ponds require a large area and are more economical in areas where land is inexpensive. Surface area requirements for naturally aerated lagoons treating various types of animal wastes are shown in Table 3-9. Because of the high BOD of livestock waste, the surface area required for these ponds may be too great to be practical for treatment, but they can be a feasible way to provide further treatment of effluent from anaerobic or mechanically aerated lagoons (Hermanson 1975).

In aerobic lagoons, oxygen is provided mechanically and dispersed throughout the pond by a compressed air diffuser or floating aerator, so these lagoons may be fairly deep. Depths of 15-20 feet may be used satisfactorily. A mechanical aerator providing oxygenation capacity 1.5 times the daily BOD loading is the minimum size recommended for continuous operation (Hermanson 1975). Volume and aerator size for mechanically aerated lagoons is shown in Table 3-10.

Anaerobic lagoons are also deep ponds, but they contain no dissolved oxygen. Because no energy is required, they are generally cheaper than aerobic lagoons. The anaerobic lagoon can decompose more organic matter for a given lagoon volume than the aerobic lagoon. They also require less land area than a naturally aerated lagoon because depth is not restricted by light penetration or oxygen needs. They should be built as deep as possible, with a small surface area. A detention time of 50 days or more is required for the best reduction of organic solids. Minimum volume for anaerobic lagoons based on type of animal is shown in Table 3-11.

Deeper lagoons with smaller surface areas provide a more favorable and stable environment for methane bacteria, minimize odors, require less land area, and encourage better mixing of lagoon contents by rising gas bubbles (Hermanson 1975). The anaerobic lagoon contains two bacterial groups that sequentially convert the wastes first to organic acids and then to methane and carbon dioxide. Odor can be a problem with anaerobic ponds. Assistance in design can be obtained from a number of sources, including IDHW, SCS, extension agents, and others. Anaerobic lagoons may be followed by an aerobic lagoon to remove additional BOD loading.

In areas of excessive soil permeability, an impermeable seal or liner may be necessary to prevent groundwater contamination from waste lagoons. IDHW recommends permeability be limited to one-quarter inch/day (Ada/Canyon 1977).

Status and Reliability. All types of lagoons are commonly used as a partial treatment process. All may experience serious upsets requiring a number of weeks to overcome. An overabundance of algae may disturb balance in the oxidation pond, and aerobic systems become anaerobic and produce odors if the

Table 3-9. Surface Area Requirements for Naturally Aerated Lagoons

		BOD (LB/DAY)	SURFACE AREA/LB OF ANIMAL (SQ FT)[a]	NO. OF HEAD/ SURFACE ACRE[a]
Poultry	(4-lb chicken)	0.014	3.0	3,570
Hog	(200-lb hog)	0.42	1.8	10
Beef	(1,000-lb animal)	1.6	1.4	31
Dairy	(1,400-lb cow)b	2.2	1.4	23

---

[a] Based on 50 lbs of BOD/lagoon acre/day. The values can be adjusted for other BOD loading rates.

b Values in this table assume the entire manure production enters the lagoon. If dairy cows are on pasture, however, manure will come only from the milking parlor and holding pens. Then 0.3 sq ft of lagoon surface/lb of cow or 100 cows/acre of lagoon will be adequate.

SOURCE: Hermanson 1975.

Table 3-10. Volume and Aerator Size for Mechanically Aerated Lagoons

		VOLUME/ANIMAL (FT^3)	VOLUME/LB OF LIVESTOCK (FT^3)	AERATOR SIZE[a] (HEAD/HP)
Poultry	(4-lb chicken)	3	0.75	3,660
Hog	(200-lb hog)	200	1.00	120
Beef	(1,000-lb animal)	750	0.75	32
Dairy	(1,400-lb cow)[b]	1,750	1.25	23

---

[a] Based on 1.5 times the daily BOD loading and aerator output of 3.2 lbs of oxygen/HP/hr. If a loading factor of 2 times the daily BOD loading is desired, multiply number of head/HP by 0.75.

[b] Values in this table assume the entire manure production enters the lagoon. If dairy cows are on pasture, however, manure will come only from the milking parlor and holding pens. Then 350 cu ft of lagoon can be used for each 1400-lb cow, or the manure from 100 cows weighing 1400 lbs each can be used/aerator HP.

SOURCE: Hermanson 1975.

Table 3-11. Minimum Volume Required for Anaerobic Lagoons

LIVESTOCK	VOLUME/LB OF LIVESTOCK (FT^3)	VOLUME/ANIMAL (FT^3)
Poultry	3	12 (4 lb chicken)
Hog	2	400 (200 lb hog)
Beef	2	2,000 (1,000 lb animal)
Dairy[a]	2	2,800 (1,400 lb cow)

---

[a] Values in this table assume the entire manure production enters the lagoon. If dairy cows are on pasture, however, manure will come only from the milking parlor and holding pens. Then 550 ft^3 of lagoon will be sufficient for each 1,400 lb cow.

SOURCE: Hermanson 1975.

aerator ceases to function. Anaerobic lagoons may become acidic and produce odors if they receive too much waste at one time (EPA 1974). Failures can be traced to improper design, construction, and management (Hermanson 1975). Overloading is the most common cause of problems (Ada/Canyon 1977).

Impacts on Farmers. General advantages of lagoons include: low labor requirements, provision of long-term storage to allow field spreading at appropriate times and reduction of fly problems. The initial investment is lower than for a liquid manure system with field spreading. General disadvantages include: need for periodic sludge removal, potential for odors, potential groundwater pollution, provision of mosquito habitat, and potentially greater use of water than alternative waste-handling systems (Hermanson 1975). The main advantages of an anaerobic system or oxidation pond over an aerobic pond are the lack of energy required and the simplicity of the system to construct. Disadvantages include strong odors during agitation, pumping, hauling, and field spreading. Flies and insects may also be a problem (Taylor 1970). All three types will require minimal operation, although some maintenance and pumping will be necessary, and proper disposal of the waste products, probably by land application, is necessary.

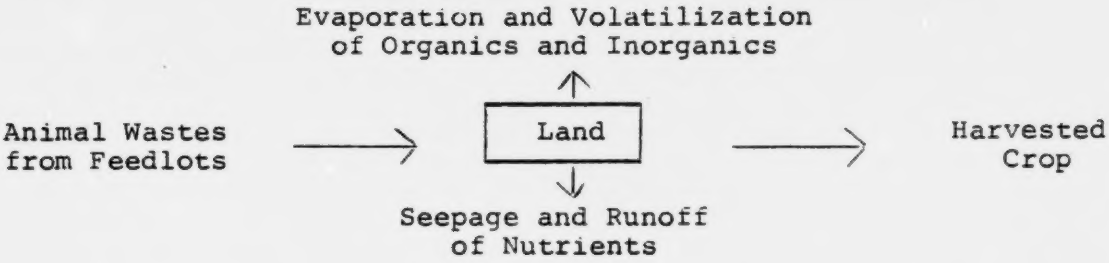
Although the initial investment to develop waste lagoons is relatively low, the value of the residual product is also low and potential water quality benefits are not as significant as with more advanced treatment technologies. If land area is limited, size requirements, especially for aerobic lagoons, could substantially affect production and revenue generation of an operator.

As previously identified, excavation costs are the principal cost item in constructing waste lagoons and are estimated at $1.00/yd^3$. The excavation costs to construct mechanically aerated lagoons for feedlot operations are estimated to range from $800 for a 60-head dairy to $9,000 for a 700-head operation. Other potential costs associated with construction of waste lagoons include sealing or glazation (estimated at $1.00/ft^2$) to protect groundwater from contamination and fencing (estimated at approximately $1.00-$1.25/lin. ft.). Mechanically aerated lagoons also will require investment in aerators.

Application in Sensitive Areas. In areas near population centers, land is often more expensive, and odors are more of a problem. In these areas, aerated lagoons are preferable to anaerobic lagoons (which may produce more odors) or oxidation ponds (which require more land). Use of these treatment processes will provide improved solids, dewatering, reduced solids volume, and odor reduction of solids spread on cropland (EPA 1974). As such, they would be preferable to simple detention ponds in sensitive areas where population centers make odors a problem.

Land Application

Description. Land application is probably the most practical final placement for farm manure and contaminated runoff. Land application of wastes has been illustrated schematically by EPA (1974) as:


Evaporation and Volatilization of Organics and Inorganics
Animal Wastes from Feedlots
Land
Harvested Crop
Seepage and Runoff of Nutrients

No generalizations concerning waste input or output are possible because site-specific conditions vary greatly. They affect not only waste content, but the extent to which waste will remain on the land and be utilized or will be lost by seepage, runoff, or evaporation. Land application of wastes may be approached from either the fertilization/irrigation aspect or merely as a means of waste disposal.

While polluting aspects of improperly managed wastes are obvious, it should not be overlooked that on the average, a 1,000-pound cow can produce up to 135 pounds of nitrogen, 58 pounds of phosphorus, and 87 pounds of potassium per year (ADA SCD 1982). When viewed in this light, manure becomes a resource which can reduce farmer costs when used properly. Developing a waste management system that suits the individual farmer's needs is the key to effective use of these nutrients and will benefit both the farmer and the environment. Approximate fertilizer value of manure for various animals is provided in Table 3-12.

When applying wastes for fertilization purposes, the application rate must be geared to requirement of the crop where it will be applied, and the application restricted to that providing optimum crop growth. Where application is made primarily for waste disposal, application rates may be higher. Gilmour et al. (1975) suggest runoff disposal to agricultural land should not exceed 2-4 inches per acre on a sustained year-after-year basis because excessive application could reduce crop yields.

Manure can be applied to the land in either solid or liquid form. Solids spreading, liquid spreading (for thick but pumpable wash slurries), and irrigation (for thin waste slurries) are the major types of application. Solid manure contains less water than liquid manure, so it can be stockpiled and then loaded onto a manure spreader, spread on the fields, and incorporated into the soil by plowing or other means. Liquid manure systems utilize storage ponds or tanks to contain the material

Table 3-12. Approximate Fertilizer Nutrient Value of Manure

ANIMAL	NUTRIENTS IN MANURE NITROGEN LB/TON	PHOSPHORUS LB/TON	POTASSIUM LB/TON
Dairy cattle	11	2	10
Beef cattle	14	4	9
Swine	10	3	8
Horses	14	2	12
Sheep	28	4	20
Poultry	31	8	7

SOURCE: SCS Agricultural Waste Management Field Manual in Ada/Canyon 1977.

until needed. Liquid spreading and hauling may be accomplished by the same piece of equipment, such as tank trucks or trailers with built-in spreaders, unless the transport distance is great. Liquid spreading equipment may vary from gravity-feed piping or ditches to high pressure pumps. Removal and application of liquid wastes can be combined in some cases by pumping directly from containment ponds to irrigation systems for field application. Liquid manure may be placed by surface spreading, soil injection, plow-cover furrow methods, or irrigation. The injection method and the plow-furrow cover method both result in the material being placed 6-8 inches below the soil surface, which reduces the opportunity for both odors and flies (Klausner et al. 1971).

The rate of application depends on the manure moisture content, type of animal waste, amount of bedding, amount of dirt incorporated with the waste (if pens are scraped), stockpiling or treatment methods prior to application, and other factors.

Incorporating the manure into the soil as soon as possible after spreading is important both to immobilize the manure constituents and to minimize flies and odors. Where it cannot be incorporated, it should be spread on fields having the greatest amount of plant material to reduce erosion and increase retention time on the surface. Losses, particularly by runoff and seepage, can be minimized by proper site selection and management practices, such as appropriate application times, rates, and incorporation methods, as well as tailwater collection and contour plowing.

Land application solely for disposal, as opposed to fertilization, is less common. Some potential problems can also result (EPA 1974):

- Crop response problems from salt toxicity
- Lack of equipment capable of applying large volumes of waste
- Odor and fly control problems
- Reduced economic value of the wastes as fertilizer
- Improper nutrient balance
- Increased application costs
- Excess nitrate for given moisture levels.

Status and Reliability. Land disposal is considered a complete waste treatment. The concept of land application for fertilization has been used successfully for many years, and reliability is considered excellent. Use of land for disposal has a shorter history and is more questionable if practiced on income-producing cropland (EPA 1974).

Impact on Farmers. One advantage of land application to the farmer is that the material applied improves soil tilth and reduces the need for expensive fertilizers. Application technology is also flexible, and application can be made in a variety of ways depending on farmer needs and equipment. Manure may contain high concentrations of soluble salts that reduce yields of some crops, adversely affect soil structure, and reduce soil permeability. Care must be taken to ensure proper application rates, particularly in the more arid regions (Gilmour et al. 1975). Ammonia toxicity and nitrate and bacterial leaching can also be problems associated with land application, depending on the location.

The fertilization/irrigation approach to land application provides greater potential for the farmer to minimize waste management costs than the disposal-only approach. The net cost of using manure to provide crop nutrients, however, depends to a large extent on local and site-specific conditions including the type of soil for application, crop management approach, climate, and local economics.

Different types of equipment are needed for land application systems depending upon the methods of storage, handling and application. For handling and application of solids, investment in additional equipment generally includes a front-end loader and box spreader. For liquid systems, equipment needs generally include storage facilities and a tank truck or wagon/sprinkler system for application.

As indicated in Table 3-13, significant differences in annual fixed costs are likely to occur for dry manure and liquid manure handling systems. Although data on operating costs are limited because of considerable site variability, the higher annual fixed costs of liquid manure systems may be offset to some extent by lower operating costs. The effects of economics of scale on average fixed costs are also evident from the data in Table 3-13.

The principal benefits of land application of animal wastes are potential savings on the use of fertilizer as indicated in Table 3-14. The current market value of the three key fertilizer components of manure - nitrogen, phosphate, and potash - is $0.17, $0.56, and $0.25 per pound, respectively (Moffett pers. comm.). Based on average amounts available per ton of manure, the potential values to farmers of applying the manure resource to crops can be estimated. It should be recognized that the values presented in Table 3-14 represent 100 percent utilization of the manure's nutrient value and that nutrient losses will occur as a result of handling, storage, and processing methods. (Refer to Tables 3-2 and 3-3 for nutrient losses associated with different processing methods.)

Table 3-13. Comparison of Annual Fixed Costs Per Head of Dry Bulk and Aerobic Liquid Manure Handling Systems for Commercial Beef Feedlots in the Caldwell, Idaho Area[a]

TYPE OF SYSTEM	ONE TIME FEEDLOT CAPACITY 500 HEAD	 3000 HEAD	 10,000 HEAD
Dry Bulk Handling System			
- Diversion Ditches[b]	$ 0.34	$ 0.14	$ 0.08
- Catchment Ponds[c]	4.08	2.11	1.42
- Loader/Spreader	5.32	4.70	2.83
TOTAL ($/head)	$ 9.74	$ 6.95	$ 4.33
Aerobic Liquid Handling System			
- Paving, Gutters, Pipe[d]	$13.63	$12.79	$11.69
- Lagoons[e]	6.58	6.58	6.58
- Pumps, Wagons, Sprinklers	5.66	1.71	.76
- Ditches, Ponds[f]	1.59	.80	.54
TOTAL ($/head)	$27.46	$21.88	$19.57

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[a] All original cost data adjusted to 1985 dollars by the Nationwide Consumer Price Index.

[b] Earth construction, minimum of two square feet cross-sectional area, seven-eighths of perimeter maximum length.

[c] 2.5 inch-24 hour rainfall runoff capacity, earth construction.

[d] 25 square feet pavement per head, 21 square feet per space per head; excess is support area.

[e] 150 cubic feet storage capacity/head annual volume.

[f] Support area surface runoff control facilities.

SOURCE: Gilmour et al. 1975.

Table 3-14. Potential Value of Applied Beef Feedlot Wastes

Fertilizer Benefit	CONTENT/ TON MANURE	PRICE/ POUND[a]	POTENTIAL VALUE
Nitrogen/ton	4 lbs. N	$ .17	$ .68
Phosphate/ton	4 lbs. P_2O_5	.56	2.24
Potash/ton	9 lbs. K_2O	.25	2.25
Fertilizer Value/ton manure			$5.17
Physical Benefit			
Increased Water Retention/ton	(1%/T)	$.007[b]	
Increased Organic Matter Content/ton		.500[b]	
Physical Value/ton manure			0.507
Total Potential Value of Applied Beef Manure/ton:			$5.67

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[a] Current market value (from Moffitt pers. comm.)

[b] SOURCE: Gilmour et al. 1975

Other benefits of land application of manure include a potential increase in water retention capability of the soil and the addition of organic matter. As shown in Table 3-14, the value of these benefits was estimated at $.007 and $.50 per ton, respectively, by the U. S. Army Corps of Engineers (Gilmour et al. 1975) on land disposal in the Caldwell, Idaho area.

The disposal-only approach to land application of animal wastes may provide some residual value to the farmer even if applied to land currently not in production. Improved soil conditions will provide opportunities for future crop production.

Application to Sensitive Areas. Surface and subsurface flow of water is the primary transport mechanism for manure from fields to waterbodies. To prevent runoff, application must be done at a time when the soil can absorb liquids, and it must be followed rapidly by soil incorporation. Application to frozen ground or saturated soil should be avoided. Land application should be practiced on flat lands, where runoff velocity and volume are naturally reduced, and application rates should be geared to the capacity of crops and soil to assimilate it. Diversion ditches and other practices to intercept surface water runoff can also be used. If these factors and practices are considered, and site-specific factors are taken into account when developing a land disposal plan, water pollution potential from land application can be substantially reduced and use of land application in sensitive areas should be acceptable. In areas of very permeable soils, where shallow groundwater exists, surface irrigation should be avoided. Overhead irrigation can minimize the danger of groundwater contamination (Gilmour et al. 1975). Spreading on land adjacent to watercourses may be restricted, depending on site-specific slope, soil, and climatic conditions. Restriction distances of 50-500 feet have been recommended by various governmental agencies (Ada/Canyon 1977).

Alternatives Most Appropriate for Sensitive Areas

As long as proper end-of-process technologies are employed, in-process technologies will generally have little effect on water quality in sensitive areas. The one exception to this may be site selection because of the far-reaching effects of topography and climate on nearly every aspect of the operation.

For existing farms in sensitive areas, developing mitigation measures for undesirable site characteristics is very important. For future sources, careful site selection is a must if water quality is to be protected.

The end-of-process technologies can all be appropriate in sensitive areas to varying degrees, depending on site-specific characteristics and individual farmer needs. Runoff control is a must for all operations. Land application is one of the few complete treatment options available. It is effective for both manure and runoff, although it must be carefully suited to the individual site conditions to assure runoff does not occur. Composting, although a complete treatment process for manure, will not deal with runoff from the manure site or from the cowyard in general. Lagoons, oxidation ditches and activated sludge processes are valuable in reducing BOD and other pollutants, but as incomplete processes, a final disposition of effluent is needed. They must also be maintained to achieve optimum performance and prevented from overflowing, if water quality is to be protected.

Chapter 4

ASSESSMENT OF REGULATORY IMPACTS

As discussed previously, EPA issued approximately 70 individual permits in the 1970s which have now expired. EPA proposes to issue a General Permit to replace and to cover other operations not previously permitted. This chapter assesses impacts of two aspects of the proposed permit: use of a General Permit (as opposed to use of individual permits) and impacts of the permit criteria.

Scope of the General Permit (Preferred Option)

The NPDES permit regulations are applicable to all operations found to produce significant water quality degradation. Regulations cover essentially three groups of operations: 1) large operations of more than 1,000 beef or more than 700 dairy cattle), 2) operations having more than 300 beef or more than 200 dairy cattle that discharge to or have contact with a ditch or waterway, and 3) smaller operations, identified on a case-by-case basis when they are found to be causing a pollution problem. Because of the large number of smaller operations, this third group causes the majority of the water quality problems, and an enforcement program encompassing all these groups is considered necessary if significant water quality improvement is to be expected and water quality standards are to be met (Jones & Stokes Associates 1985). Limiting the permit coverage to the larger operations in the first two groups will produce little water quality improvement, particularly in the Twin Falls and Blackfoot areas, where the great majority of the operations are small (fewer than 200 animals).

The permit will therefore be required of all dairies and feedlots containing more than 700 and 1,000 animals, respectively, and all dairies and feedlots with more than 200 and 300 animals, respectively, that discharge to or have contact with a ditch or waterway. Under this preferred option, smaller operations contributing to water quality degradation will also be asked to apply for General Permit coverage or submit an NPDES application for an individual permit on a case-by-case basis, as they are identified. Because of their large numbers, effort will be concentrated on operations in the priority drainages identified in Chapter 2 (Table 2-16), particularly those most severely impacted by dairy and feedlot wastes.

Based on the aerial survey, previous permitting activity, and conversations with numerous state and county personnel, operators in the first two categories are likely to number approximately 200. An additional 200-400 of the smaller dairy and feedlot owners could eventually be asked to apply for permit coverage. The actual number affected will depend on the degree of effort devoted to this time by IDHW, which in turn depends on manpower, priorities, water quality conditions in the various stream segments, and numerous other factors. This option is believed to provide the greatest flexibility for EPA because it takes advantage of the benefits of a General Permit, but also allows the option of individualized permits on a case-by-case basis as needed.

Impacts of the General Permit Approach

The concept of a General Permit for Idaho feeding operations is not new. A General Permit was proposed in 1981 but was never finalized. The permit would have allowed for issuance of individual permits where potentially severe water quality impacts existed. It would also have allowed the state and areawide 208 planners to request exclusion of an operation from the General Permit when more stringent permit limitations were desirable. The permit was intended to apply to beef cattle feedlots (SIC 0211), hog feedlots (SIC 0213), sheep and goat feedlots (SIC 0214), general livestock (SIC 0219), dairy farms (SIC 0241), poultry farms (SIC 0251-0254 and 0259), and animal specialties (SIC 0271). The proposed permit system will cover the same categories.

Under a General Permit, feedlot and dairy owners falling under the categories established in the permit would have to notify EPA of their intent to be covered under the General Permit. The General Permit would establish a set of discharge criteria that would apply generally across-the-board to all operations under the permit. During review of the plan, additional site-specific conditions could be included in the permit as necessary for water quality protection. Individuals requesting coverage would have to submit a Notice of Intent to the director within 30 days of permit issuance and an operating plan within 60 days of the effective date of the permit. Individuals falling under scope of the permit but not covered by the permit would not be authorized to discharge, and would be in violation should a discharge occur.

This procedure would preclude the need for EPA to draft and issue numerous individual permits, and would greatly decrease time required for permit issuance. Likewise, permit application requirements would be simplified for the applicant, and burdensome mandatory inspections would also be eliminated.

Because the General Permit and individual permits would contain essentially the same requirements, the primary impact related to permit type is expected to be administrative, assuming enforcement efforts are equal under both permit types. For the issuing agency and the operators covered by the General Permit, issuance of a General Permit is expected to reduce time and effort expended. No negative impacts to the agency, owners, or environment are expected. Jones & Stokes Associates (1985) has assessed General Permit programs for confined animal feeding in other states and makes several general conclusions concerning the use and feasibility of General Permits for confined animal operations in Idaho:

- Permit conditions under a General Permit may be identical to those of individual permits, but EPA and state personnel agree that General Permits reduce paperwork. During the application phase of a program, they eliminate time-consuming review of individual applications by the permitting agency and can also reduce industry's burden in applying for and obtaining a permit. The degree to which compliance and inspection paperwork is generated or reduced depends primarily on the enforcement emphasis of the permitting agency, rather than the form of the permit used.

- The paperwork reduction frees time that can often be used for higher priority activities, such as inspections. This can be a particularly important aspect of a General Permit where manpower is limited.

- Once understood by the agricultural community, feedlot General Permits have been well accepted. In no case, however, have the General Permits varied to any great degree from the individual permit requirements. Should this occur, farmer acceptance may be less enthusiastic.

- A General Permit provides at least the framework for a more uniformly-administered program and less arbitrary enforcement.

- A General Permit will not automatically result in improved water quality, nor is it likely to increase the number of operators that express interest in the program.

- General Permit effectiveness depends on state and federal attitudes concerning enforcement. It also depends on the degree to which the permitting agency establishes and maintains a good tracking system and implements an inspection program and compliance monitoring.

- A General Permit cannot cover all site-specific situations. Some individual permits may still be necessary if complete water quality protection is required or if an operation has a variety of discharges.

- The possibility exists that the enforcement agency will lose track of individual sources under a General Permit. This is particularly possible under a federally-administered program where EPA program headquarters are located out of state. In such a situation, strong support and encouragement of state enforcement efforts is valuable.

Impacts of the Permit Conditions

Description of Permit Requirements and Criteria

Previous permits required that existing facilities meet Best Practicable Control Technology (BPT), i.e., contain process waste plus runoff from a 10-year, 24-hour rainfall event. They prohibited discharges to waters except when caused by a "chronic or catastrophic" rainfall event. New Source Performance Standards (NSPS) require containment of process waste plus runoff from a 25-year, 24-hour rainfall event. The actual difference between these storms in many areas is less than 0.4 inch. Both requirements have been found insufficient in many colder states because they do not take frozen ground and the need to store cumulative winter rainfall into account. Some states require up to 5 or 6 months of storage capacity for times when manure cannot be spread onto fields (EPA 1974). In Idaho, climatic conditions indicate at least a 4-month holding period is necessary (Jones & Stokes Associates 1985). This is consistent with SCS and IDHW plans, which normally require holding periods of 3-6 months depending on location.

The proposed permit will require facilities to accommodate process waste, runoff from a 25-year, 24-hour storm event, and 3 inches of runoff (no absorption), which is approximately equal to runoff expected from 4 months of winter runoff as expected from a 1- in 5-year winter. For operations along the Snake River drainages, when adjustment is made for evaporation, this is equivalent to designing for a net runoff of approximately 4 inches. See Jones & Stokes Associates (1985) for an in-depth discussion deriving these criteria.

The permit also requires the following best management practices to control and abate runoff discharges:

1. Flowing surface waters (rivers, streams, and canals) will be prohibited from contact with animals confined within the operation;

2. Waste disposal by land application will not create a public health hazard and must comply with all state land application regulations;

3. Solids, sludges, or other materials removed by treatment of wastewaters must be disposed of in a manner that prevents their entering waters of the United States; and

4. Wastes from dipping vats, pest and parasite control units, and similar facilities must be disposed of in a manner that prevents their entering waters of the United States.

Within 6 months of permit issuance, an operating plan will be required from each operation covered by the permit. The plan will establish practices to be followed in operating the facility, diverting and controlling runoff, and in dewatering, removal, and disposal of solids. An additional description of the plan is provided in the General Permit (Appendix D).

Environmental Impacts of the Permit Criteria

Past criteria required only containment of a 25-year storm and did not take the need for storage of cumulative precipitation into account. An analysis of cumulative precipitation for the Boise area indicated that cumulative precipitation often exceeds the volume expected from a 25-year, 24-hour storm event (Jones & Stokes Associates 1985). As a result, feedlot and dairy discharges are common, even from impoundments constructed to contain a 25-year storm (climatologic data for representative areas along the Snake river are shown in Appendix C).

Under the proposed permit criteria, discharges from properly constructed feedlots or dairy operations would be limited to times when precipitation during the 3- to 4-month holding period is greater than that expected for a 1- in 5-year winter (a 20 percent possibility) that also experiences a 25-year, 24-hour storm (a 4 percent possibility). Discharges will still occur occasionally in very heavy precipitation years, particularly if recommended management practices, such as pumping, are not followed prior to onset of winter; but the number and frequency of discharges should be greatly reduced.

Impacts of dairy and feedlot discharges are described in Chapter 2. If facilities are constructed to meet the new criteria, in areas where dairies and feedlots are the primary sources of impact, significant water quality improvement in streams and canals will be noted. It is impossible to predict the exact degree to which improvement will occur, because it will be dependent upon the amount of waste reduction, the amount of receiving water flow, pollutant contributions from different types of sources, and other factors.

The reduction in discharges will affect a number of water quality parameters. Dissolved oxygen levels should rise, and BOD, nutrient, bacteria, and sediment levels should be reduced. This, in turn, should provide benefits for aquatic wildlife, result in cleaner canals and irrigation water for irrigators, and reduce the potential for fish kills, clogged irrigation equipment, weed growth in canals, and eutrophication of stream segments. Benefits should be most obvious in winter and spring, because these are the months in which the greatest number of discharges generally occur.

Impacts of the Criteria on Permit Administration

The impacts on EPA permit personnel from any permit issuance will depend primarily on the type of permit issued, the number of operations included in the permit, and the aggressiveness of the enforcement program, rather than on the stringency of the criteria themselves. An exception may occur if permit requirements are lengthy and involve numerous reviews by enforcement personnel. As all permits will contain permit criteria of some type, the revision in permit criteria themselves should pose little or no additional administrative burden on EPA.

Impacts of the Criteria on Operators

The permit criteria will require a greater amount of runoff to be contained than was required under the previous permit. This will produce both positive and negative impacts on farmers. The criteria will result in much more effective containment, and there will be positive impacts from the decrease in discharges. The decrease in discharges will result in cleaner water for other farmers and irrigators using canals impacted by upstream wastes. There will be less overflow of manure onto neighboring properties, which will reduce fly and odor problems, and reduce the health hazard accompanying manure overflows. There will also be less ill will and problems between neighbors if manure can be contained on-site.

The major impact on farmers will be economic, because the new criteria will require an increase in holding capacity. Operators will need to enlarge existing facilities or construct new facilities somewhat larger than those which were previously required. Increased size will require additional land for containment, unless existing facilities are deepened. In regions such as parts of the Twin Falls area, where lava beds limit depth of existing impoundments to 3-4 feet, any containment expansion will mean an increased surface area will be necessary. (Shallow impoundments will allow greater natural oxidation to occur, however, and this will produce a better quality of waste.)

It is often more difficult to enlarge an existing impoundment than to construct a new one. Few operators presently construct holding ponds for runoff, and process waste ponds are often fenced to prevent entrance of runoff water. In these cases, construction of a new, separate pond only for runoff may be the easiest method of compliance.

The degree to which impoundment size must be increased will depend upon the size of existing facilities in terms of both number of animals and size of the area generating runoff.

The containment volumes required under the old and the newly proposed criteria are estimated in Table 4-1 for four different-sized dairy and two different-sized feedlot operations. As presented, feedlot operators would be required to increase the impoundment capacity by over 160 percent for both small and large-scale operations. The percentage volume increase for dairy operators would be considerably less, ranging from approximately 27 percent to 108 percent.

Excavation costs for impoundment expansions under the new criteria are estimated in Table 4-2. For dairy operations, the cost impact on farmers would be approximately $2,000 to $2,600 for a 6-acre facility and approximately $5,000 to $6,600 for a 15-acre facility, based on the assumptions in Table 4-1. For feedlot operations, the cost impact is estimated at between $3,300 and $4,400 for a 10-acre facility and between $16,600 and $22,000 for a 50-acre facility.

Based on a 14 percent amortization rate, the annual fixed cost increase to dairy operators for pond expansion would be approximately $300 for a small (6-acre) operation, and $700 for a large (15-acre) operation. Feedlot operators would incur additional annual fixed expenses of approximately $560 and $2,500, respectively, for small (10-acre) and large (50-acre) facilities.

For dairy and feedlot operations that presently provide no containment of runoff, the cost impact will be significantly higher than the dollar amount indicated in Table 4-2. Under these circumstances, the operator would be required to excavate the total volume indicated under the "New Criteria" category in Table 4-2. In addition to excavation costs (estimated at between $.75 and $1.00/yd^3), the operator also would likely incur costs for related improvements, such as ditches or other diversion facilities.

For operations with space constraints where an increase in depth of existing impoundment areas is not possible, compliance with the new runoff criteria may require that the area presently used for livestock production be reduced. As discussed in the Site Selection section of Chapter 3, the capacity of a 3,000-head feedlot would need to be reduced by approximately 440 head (assuming requirements of 200 sq ft/head) to accommodate

Table 4-1. Comparison of Impoundments for Representative Dairy and Feedlot Operations Under Old and Proposed Runoff Containment Criteria

Case Number	Type Facility	Size Acres	Total Head	Type Wash	Runoff Criteria	Precip. Runoff	Waste Volume	Wash Volume	Active Storage Volume (Cubic Ft)	Pond Side Length*	Pond Area (Sq. Ft.)	Pond Area (Acres)	Excavation Volume (Cubic Ft)	Excavation Volume (Cubic Yds)	Percent Increase in Volume
1	Feedlot	10	200	N/A	Old	54,450	N/A	N/A	54,450	98	9,539	0.22	72,040	2,668	
2	Feedlot	10	200	N/A	New	145,200	N/A	N/A	145,200	148	21,826	0.50	190,637	7,061	164.63%
3	Feedlot	50	3,000	N/A	Old	272,250	N/A	N/A	272,250	195	38,022	0.87	357,768	13,251	
4	Feedlot	50	3,000	N/A	New	726,000	N/A	N/A	726,000	305	93,298	2.14	957,467	35,462	167.62%
5	Dairy	6	60	Hand	Old	32,670	13,810	2,888	49,367	94	8,806	0.20	65,447	2,424	
6	Dairy	6	60	Hand	New	87,120	13,810	2,888	103,817	128	16,354	0.38	136,413	5,052	108.43%
7	Dairy	6	200	Sprinkler	Old	32,670	46,032	37,219	115,921	134	17,971	0.41	152,255	5,639	
8	Dairy	6	200	Sprinkler	New	87,120	46,032	37,219	170,371	158	25,092	0.58	223,686	8,285	46.92%
9	Dairy	6	400	Sprinkler	Old	32,670	92,064	74,439	199,173	170	28,788	0.66	261,547	9,687	
10	Dairy	6	400	Sprinkler	New	87,120	92,064	74,439	253,623	189	35,684	0.82	333,224	12,342	27.40%
11	Dairy	15	700	Sprinkler	Old	81,675	161,112	130,267	373,054	225	50,534	1.16	490,744	18,176	
12	Dairy	15	700	Sprinkler	New	217,800	161,112	130,267	509,179	259	67,171	1.54	670,593	24,837	36.65%

Assumptions:

Total Depth - Feet	12
Solids/Inactive Storage - Feet	2
Freeboard - Feet	1
Sideslopes	2:1
Surface Runoff - Old Criteria - Inche	1.5
Surface Runoff - New Criteria - Inche	4
Beef Cow Effluent - CF/Cow/Day (800#	0.8
Dairy Cow Effluent - CF/Cow/Day (1400	1.92
Dairy - Hand Washing - CF/Cow/Day	0.40
Dairy - Sprinkler Washing - CF/Cow/Da	1.55
Retention Period - Months	4

* Side of Square Pond

Table 4-2. Projected Cost Impact on Dairy and Feedlot Operators from Implementation of New Runoff Criteria[1]

TYPE OF OPERATION/ CAPACITY	FACILITY SIZE (ACRES)	Excavation Volume (Yd^3)			COST IMPACT[2]
		OLD CRITERIA	NEW CRITERIA	CHANGE	
Dairy					
60 head	6	2,424	5,052	2,628	$1,971-2,628
200 head	6	5,639	8,285	2,646	$1,984-2,646
400 head	6	9,687	12,342	2,655	$1,991-2,655
700 head	15	18,176	24,837	6,661	$4,995-6,661
Feedlot					
200 head	10	2,668	7,061	4,393	$3,294-4,393
3,000 head	50	13,251	35,462	22,211	$16,658-22,211

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[1] Based on assumptions identified in Table 4-1.

[2] Includes only excavation costs, estimated at \$0.75 and \$1.00/yd^3.

the impoundment requirements without increasing pond depth. An impact of this magnitude would have a significant effect on the economic viability of the feedlot operation.

In summary, the extent to which an operator would be impacted from implementation of the new runoff criteria greatly depends on site-specific conditions. Although all operators will incur excavation costs to expand existing areas, or to develop new impoundment areas, it would appear that only a small number of operators would need to reduce production capacity to meet the new runoff criteria. The availability of financial assistance through existing federal and state programs will help to minimize the cost impact on the farmer.

Irreversible Impacts and Irretrievable Commitment of Resources

Because groundwater contamination is more difficult to rectify than surface water contamination, great care should be taken to assure that reducing surface water contamination is not accomplished at the expense of the groundwater quality. Each impoundment must be designed with site-specific characteristics in mind to ensure that pollution is minimal. Impoundments that are designed incorrectly (i.e., those in porous areas that are not sealed) could become channels facilitating entrance of pollutants to the groundwater. This would be particularly critical along the Snake River, above the Rathdrum prairie aquifer, and in other localized areas that support quality groundwater. Should contamination occur, aquifer cleanup would be very difficult.

A certain monetary commitment will also be involved in impoundment construction and other on-site improvements, although the improvements would be reversible.

Chapter 5

ALTERNATIVE PERMIT APPROACHES

Chapter 4 described the preferred permit approach, which combined the issuance of a General Permit for larger operations, with the inclusion of smaller operations on a case-by-case basis through use of either individual permits or by incorporation under the General Permit, depending upon the individual situation and needs. This chapter describes and briefly analyzes alternative approaches to the permitting process.

Several alternative permitting approaches are possible for feedlot and dairy regulation in Idaho. These include:

- Maintain status quo (no action)
- Issue individual permits
- Issue a General Permit
- Issue a General Permit that requires special provisions for farms in sensitive areas

These alternatives are discussed below in terms of their impact on the environment, on the operators, and on the EPA administrative burden. Much of the environmental benefit derived from any permit system will depend on the level of enforcement pursued by EPA. Evaluation of the environmental impact for the permit options below assumes an equal enforcement effort for all alternatives.

Alternative 1: No Action

Description. This alternative would essentially maintain the status quo. No permits would be issued and present conditions would continue. Few waste facilities will be constructed. New source operations will continue to increase in number, and most will not have proper containment facilities. Few existing operations will upgrade their facilities. Water quality will remain poor or degrade further. In addition, EPA will not be meeting its responsibilities under the Clean Water Act, and water quality standards violations will continue to occur.

Some facility design and construction activities are being encouraged by IDHW and SCS, and this would be expected to continue; but the number of operations affected directly by these efforts and the number that construct proper facilities (i.e., those successfully containing runoff) is quite low. Enforcement or mitigation activities are generally initiated by complaints or "crisis" situations. As a result, facility construction is scattered among various drainage basins. In some cases, special programs are instituted through a Rural Clean Water Program Grant or state water pollution control funds, such as the project underway in the Rock Creek drainage, but these programs are generally localized in scope and few in number because of limited funding.

Environmental Impacts. Water quality improvement in most river segments where feedlots and dairies presently exert heavy impact will remain poor. In areas such as the Magic Valley, where the number of new sources is increasing, water quality in rivers and canals will continue to degrade. This effect will be most prominent in the Southwest, Upper Snake, and Bear River Basins and probably some areas of the Clearwater Basin as well. Many of these areas support threatened, endangered, or priority fish species. The indirect problems associated with dairy and feedlot discharges including clogged irrigation water intakes, weed growth in canals, fish kills from manure and weed-reducing chemicals, and fly and odor problems will continue.

Administrative Impacts. This alternative will produce no additional administrative burden on EPA, and conditions will remain as at present. Under this alternative, state and local agencies, such as IDHW, the canal companies, district health departments, SCS, and others, because of their local involvement and presence, will be forced to continue accepting most of the burden dealing with discharging operations, although there are inadequate legal mechanisms at the state level for the effective control of these operations.

Impacts to Operators. There will be no new impacts to operators under this alternative.

Alternative 2: Issue Individual Permits

Description. Under this alternative, individual permits would be issued for each facility, as was previously done. Each facility would be required to submit an NPDES application form for review and approval, and individual permit numbers, reporting and monitoring requirements, and management practices would be established for each applicant. Facilities would be inspected at various intervals. Two potential permitting scenarios are possible under this alternative. Permits could be issued for all feedlots and dairies of more than 1,000 and 700 animals, respectively, and for all operations of more than 300 and 200 animals, respectively, where operations discharge directly to a waterway or canal. A second option would be to also include those operations that cause significant degradation to waters regardless of their size, as allowed by the Appendix B regulations. The first option would involve permitting approximately 200 operations; the second would involve issuance of perhaps 200-400 additional permits. Permit conditions and requirements would be essentially the same as those under Alternative 3 and most operations under Alternative 4 (described in the previous section).

Environmental Impacts. Some positive environmental impacts would be expected from the reestablishment of any permit system. The degree of environmental benefit derived would depend primarily on the number of permits issued, the location of the permitted facilities, and the degree to which enforcement of the permit conditions is aggressively pursued. If only larger operations are included on the present program, the only area likely to benefit would be the area near Caldwell, which contains the majority of the large feedlot operations. To be effective in most areas, smaller operations must be included, particularly in areas experiencing significant impact from dairies and feedlots in the Twin Falls and Pocatello/Blackfoot areas.

The number of permitted operations would be increased several fold over the previous permitting effort if operations fewer than 300 cattle or fewer than 200 dairy cows are included. Unless a significant difference in manpower or other factors were noted, results would likely be little different from the previous permit program. In fact, because of the increased number of permitted operations, even less time for actual enforcement would be available. An individual permit program would likely become a paper exercise with little environmental benefits if a large number of smaller operations is included. If the smaller operations are omitted, the program will not address the main source of the problems. Thus, neither system will provide maximum efficiency.

Administrative Impacts. This alternative would place a moderate-to-heavy burden on EPA enforcement personnel. An NPDES application form would be required that would necessitate the lengthy process of application review, compliance monitoring, and inspections. Because of manpower limitations, time which could be better spent on other matters would be spent on such tasks as application review and approval.

Impact to Operators. Experience in other states have indicated that the application procedures for individual permits can be somewhat more involved and time consuming than those under a General Permit. Other impacts to operators would not differ from those of a general permit, as the same requirements and criteria would apply. As with other permit alternatives, the number of operators impacted would depend on how many of the smaller operators were permitted. Economic impacts would be similar to those of Alternative 3, but less than those for many operators under Alternative 5.

Alternative 3: Issue Only a General Permit

Description. Under this alternative, a General Permit would be issued for the entire state. Operations regulated under the permit would consist of feedlots of more than 1,000 and dairies of more than 700 cows, and feedlots of more than 300 and dairies of more than 200 cows that discharge directly to waterways and canals. The permit would not list names of permittees, but individual files would be established for each operation.

EPA would require all operators in the above categories to submit an application form requesting inclusion in the General Permit. Feedlot operations of fewer than 300 animals and dairies of fewer than 200 animals would be added on a case-by-case basis, as operations causing degradation were encountered. The permit would require submission of an abbreviated application form and would require each operator under the permit to develop a management plan and restrict access as required under Alternative 2.

This alternative is somewhat limited in flexibility because one set of permit conditions cannot deal effectively with all site-specific situations that may arise. For maximum efficiency, a single General Permit would be required to contain a great deal of detail to ensure water quality protection in all cases. Alternatively, if it were more general, it would likely be insufficient to ensure water quality protection in all cases. Given the wide range in size of operations and production methods, the lack of flexibility would produce benefits for both the operators and the environment.

Environmental Impacts. As stated earlier, environmental impacts of any alternative will depend primarily on the aggressiveness of enforcement and degree of involvement of EPA personnel. Because a general permit would free the EPA of some additional paperwork, personnel could more effectively utilize their time working on actual mitigation measures. The resulting beneficial impact on environmental quality would be somewhat greater than expected under individual permits. Without individualized site-specific permits for the smaller operations (less than 300 animal feedlots and less than 200 animal dairies), the potential for water quality improvement will be somewhat reduced because the smaller operations are so numerous and widespread.

Administrative Impacts. This alternative would impose the least administrative burden of all alternatives except for the No Action alternative. Application and compliance monitoring procedures could be streamlined, resulting in less paperwork and allowing time to be spent on other matters of greater priority.

Impacts to Operators. Experience in other states indicates the operators' application time and effort would be reduced somewhat under a General Permit. The number of operators affected would be little different than under the other alternatives. Economic impacts would remain essentially the same as for Alternatives 2 and 3 but less than that for some of the operators under Alternative 5.

Alternative 4: Issue a General Permit with Special Provisions for Sensitive Areas

Description. In this alternative, a statewide General Permit would cover all feedlot and dairy operations of more than 1,000 and 700 animals, respectively, and all operations of more than 300 and more than 200 animals, respectively, that discharge directly to waterways or canals. The permit would also list a number of sensitive areas (Section 3) and would be required for all operations identified as causing water quality degradation within these areas. Operations within these sensitive areas would be subjected to additional criteria on a case-by-case basis as segment-specific and operation-specific conditions warranted. Permit requirements might include the need for alternative technology, a more detailed management plan, or additional runoff controls. As a result, some might experience additional costs, outlays, or loss of productivity in order to meet water quality requirements.

Environmental Impacts. This alternative would be expected to provide the best water quality protection of all the alternatives because it would minimize the routine paperwork of EPA, allowing the limited EPA staff to use their time in the most productive manner, and provide potentially more complete control in sensitive areas. It would ensure enforcement proceeded on a drainage-wide basis, which would be more effective than scattered enforcement, and it would draw attention to the sensitive areas. Identification of these sensitive areas could also make certain drainages less attractive to future sources because of the sensitive area designation and the resultant need for additional or more stringent control requirements.

Administrative Impacts. Burden to EPA personnel would be low-to-moderate under this alternative. Although the use of a General Permit would decrease the application and compliance paperwork, inclusion of all operations in the sensitive areas could require substantial additional time, depending on the EPA treatment of these areas. To be effective in sensitive areas, some site-specific measures are needed, although much of the burden for development of these measures can be placed upon the operator by requiring a site-specific management plan.

Impacts to Operators. Impacts to operators should be little different than for other alternatives with the possible exception of operators located in the sensitive area drainages. These operators could, on a case-by-case basis, be required to provide additional process control or technology to decrease impact from their operation. These sensitive area drainages would include both those designated from a preservation standpoint (and presently with few dairies or feedlots) and those drainages presently heavily impacted by dairy and/or feedlot wastes. Sensitive or priority drainages were discussed in Chapter 3. At a minimum, those drainages experiencing heavy impact from dairies and feedlots would be considered as sensitive.

This alternative would be likely to affect the largest number of farmers, as all those within a sensitive area would be potentially subject to any conditions required. Economic impacts would vary somewhat, depending on site-specific conditions and additional technology required.

Economic impacts for 6- and 15-acre dairies and 50- and 10-acre feedlots were discussed in Chapter 4. Economic impacts of alternative process and control technologies, which could be applicable in some sensitive area situations, were also discussed in general terms.

Table 5-1 summarizes and contrasts the four alternative permitting strategies and the preferred alternative described in Chapter 4 in terms of relative impact to environment, the operators, and EPA administrative burden.

Table 5-1. Estimated Relative Impact Comparison of Permit Program Alternatives

ALTERNATIVE	BENEFICIAL ENVIRONMENTAL IMPACT	OPERATOR IMPACT	EPA ADMINISTRATIVE BURDEN
Combined general and individual permits (preferred action)	Moderate-high	Moderate	Moderate
1 (No action)	Negative impact	None	None
2 (Individual permits)	Low	Moderate	High
3 (General Permit)	Moderate	Moderate	Low
4 (General Permit/ sensitive areas)	Moderate-high	Moderate-high	Moderate-high

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APPENDIX A

Aerial Survey Results and Previously Permitted Facilities

Table A-1. Previously Permitted Operations in the Caldwell Area

PERMIT NUMBER	EXPIRATION DATE	NAME[a]	AREA	RECEIVING WATER	RECORDED COMPLAINTS
			PERMITTED FEEDLOTS		
002307-8	6/13/79	*Armour & Company	Nampa	Boise R (via Indian Cr)	
002132-6	6/21/79	*Bivens Livestock Co.	Payette	Wieser R (via L. Payette Canal)	12/13/83
002147-4	6/21/79	*Bower Feedlot	Marsing	Snake R (via Ischam Drain)	12/14/83
002133-4	5/28/79	*Bruneau Cattle Co.	Bruneau	Snake R (via Jacks Cr)	
002214-4	6/21/79	*Clayne Cooper (C. M. Ranch)	Emmett	Payette R	
002188-1	5/28/79	*Don McGhehey (Theodore J. Stutz; Mule Shoe Bar Ranch)	Hammett	Snake R	
002593-3	--	Drees Feedlot	Homedale	Drainage ditch	
002174-1	6/21/79	Emmett Feedlot, Inc. (Holstein Heifer Ranch; Emmett Cattle Corp.)	Emmett	Payette R	~5/9/73
002272-1	6/20/79	*Farmer Cattle Co.	Marsing	Snake R (via Wilson Cr)	
002195-4	6/21/79	*George Ray Obendorf Feedlot (Ray Obendorf Feedlot)	Parma	Snake R	
002472-4	6/2/82	*H. H. Keim Co., Ltd.	Nampa	Indian Cr	
002115-6	5/28/79	*Holbrook Ranches, Inc.	Bruneau	Snake R (via Jack & Little Jack Cr)	
002211-4	6/4/79	*I.O.N. Cattle Company, Inc.	Middleton	Boise R	
002153-9	6/21/79	*Idaho Feedlot Co.	Wieser	Snake R	
002154-7	6/21/79	*Idaho Feedlot Co.	Star (Eagle)	Boise R	Numerous in 1974, 75, 76, 78, 79, 80, 82, 83, 84
002162-8	6/21/79	Idaho Meat Packers, Inc.	Caldwell	Boise R & Indian Cr (via drains)	
002163-6	6/21/79	*J. Howard Kent Beef Feedlot (Kent Ranch Co.)	Caldwell	Boise R (via Sidenberg Canal)	
002197-1	6/21/79	*Johnson Cattle Co., Inc.	Wilder	Snake R	2/12/79
002228-4	6/21/79	Lone Star Cattle Co., Inc.	Nampa	Boise R	
002246-2	6/21/79	P&B Feedlot, Inc.	Melba	Snake R	
002300-1	6/13/79	*Quarter Circle DJ Ranch	Eagle	Boise R (via Foothill Ditch)	
002131-8	6/11/79	R. L. Cattle Company	Nampa	Boise R (via drain canal)	
002471-6	6/2/82	Richard D. Rutledge	Caldwell	Boise R (via Hartley Gulch Cr)	2/15/80
002218-7	6/21/79	*Simplot Feedlots, Inc. (#3)	Caldwell	Boise R (via ditch)	12/14/83; 2/13/84
002216-1	10/31/79	*Simplot Livestock Co. (Simplot Feedlot #1)	Grandview	Snake R (via canal)	3/30/84

Table A-1. Continued

PERMIT NUMBER	EXPIRATION DATE	NAME[a]	AREA	RECEIVING WATER	RECORDED COMPLAINTS
			PERMITTED FEEDLOTS		
002217-9	10/31/79	Simplot Livestock Co. (#2)	Boise		
002458-9	6/2/82	*Tiegs Farm, Inc.	Nampa	Indian Cr	
002235-7	6/21/79	*Western States Cattle Company	Notus	Boise R	
002196-2	6/21/79	Wilder Cattle Co.	Wilder	Boise R	
002233-1	6/21/79	Higby Cattle Co. (Wright Cattle Company)	Payette	Payette R (via Willow Cr)	
			PERMITTED DAIRIES/POULTRY		
002282-9	6/4/79	*American Dairy Heifers (Columbia R. Assoc.)	Payette	Snake R (via Payette R)	
000040-0	3/30/79	Boise Associated Dairies	Boise	Boise R	
002374-4	9/26/79	Dari Vest Farms, Inc. (Case Visser Dairy)	Parma	Snake R	
002447-3	6/30/80	*Hank Vanderwey Dairy Farm	Caldwell	Boise R	5/6/75; 2/27/77; 12/12/78; 1/5/79; 2/26/79
002215-2	6/21/79	*Simplot Poultry, Inc. (dba Valley Storage Co.)	Meridian	Lake Lowell (via Ridenbaugh Canal)	
002219-5	6/21/79	*Simplot Poultry, Inc. (dba Intl. Cattle Exports)	Meridian	Boise R	
002116-4	5/28/79	*Triangle Dairy, Inc. (Caldwell Dairy)	Grandview	Snake R (via Shoofly Cr)	6/29/83 (operational problems)

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* Identified Volume 1 of the aerial survey (EPA 1984a).

[a] Names in parentheses indicate previous name or other identifying name under which information exists in IDHW files.

SOURCES: EPA and IDHW files.

Table A-2. Confined Animal Feeding Operations Identified by Aerial Survey in the Caldwell Area

FEEDLOTS

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS[b]	RECEIVING WATER [c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[m]	IMPOUNDMENTS (#, ACRES)	LOCATION
1	Idaho Feedlot*	50	<50	None	None/--	F	3; 1 AC	Wieser
3	Bivens Livestock Co.*+	32	>1000	SWB 420[i]	None/56	M/S	None	Payette
4	-----	26	201-700	SWB 340[d]	None/85	M	None	Homedale
5	C. M. Ranch*	18	201-700	SWB 340	Direct access	M/S	None	Emmett
6	Hilltop Feedlot	60	>1000	SWB 30	None/570	M/S	10; 5 AC	Nyssa
7	George Obendorf*	29	<50	None	None/1300	M	None	Parma
8	Western States Cattle Co.*	15	201-700	None	None/25	F	3; 0.2 AC	Notus
9	Simplot Feedlots, Inc.*+	300	>1000	SWB 280	None/10	F	16; 12 AC	Caldwell
10	Johnson Cattle Co., Inc.*	78	<50	None	None/42	F	None	Wilder
12	Bower Feedlot*+	15	>1000	SWB 20	None/40	S	None	Marsing
13	______________[n]	13	201-700	SWB 20[e]	Direct access	F/M	None	Homedale
15	I.O.N. Cattle Company, Inc.*	22	<50	SWB 270	Direct access	F	None	Middleton
16	Kent Ranch Co.*	60	>1000	SWB 280	Direct access	F	3; 2.3 AC	Caldwell
17	H. H. Kiem Company, Ltd.*	10	201-700	SWB 280[f]	None/20	F	None	Nampa
18	Armour & Company*	11	201-700	Canal	None/20	F	None	Nampa
19	Tiegs Farms, Inc. #1*	7	201-700	Lk Lowell[g]	None/20	F	None	Nampa
20	Tiegs Farms, Inc. #2	4	201-700	Lk Lowell(?)	None/20	F	None	Nampa
21	Idaho Feedlot Co.*+	192	>1000	Irg. ditch	Direct access	F	4; 2.5 AC	Eagle
22	Quarter Circle DJ Ranch*	7	<50	Canal	None/10	F	None	Eagle
25	Farmer Cattle Co.*	75	>1000	SWB 20[h]	Direct access	F	7; 2 AC	Marsing
26	Hackler Feedlot	30	>1000	SWB 20(?)	Direct access	F	None	Marsing
27	Simplot Livestock Co.*+	200	>1000	Irg. ditch	Direct access	F/M	None	Grandview
29	Bruneau Cattle Co.*	80	>1000	SWB 10[j]	Direct access	F	None	Bruneau
30	Holbrook Ranches*	26	>1000	SWB 10[j](?)	None/10	F/M	None	Bruneau
31	Don McChehey*	5	<50	SWB 10[k]	Direct access	F/M	None	Hammett

DAIRIES AND POULTRY

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS[b]	RECEIVING WATER [c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[m]	IMPOUNDMENTS (#, ACRES)	LOCATION
2	American Dairy Heifers #1*	47	700-1000	SWB 340	Direct access	F	3; 1.5 AC	Payette
11	Owyhee	7	51-200	SWB 20	None/47	M/S	1; 0.8 AC	Homedale
14	Hank Vanderwey Dairy*+	18	201-700	None	None/10	F	1; 0.6 AC	Caldwell
23	Simplot Poultry #1 (Poultry)*	-	<50(?)	Riden. C.	Direct access	F	None	Meridian
24	Simplot Poultry #2 (Dairy)*	-	<50	Irg. ditch	Direct access	F	None	Meridian
28	Triangle Dairy*	35	>1000	SWB 20[l]	None/135	F	None	Grandview

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[a] * = Permitted; + = Water quality complaint received by IDHW.

[b] It should be noted that number of animals may vary substantially depending on time of year.

[c] SWB 420 - Wieser R (Midvale to mouth)
SWB 40 - Snake R (Payette R - Brownlee Reservoir)
SWB 340 - Payette R (Black Canyon Dam to mouth)
SWB 30 - Snake R (Payette R to Boise R)
SWB 280 - Boise R (Caldwell to mouth)

Table A-2. Continued

SWB 270 - Boise R (Mile 50 : Vet St. Park - Caldwell)
SWB 20 - Snake R (Strike Dam to Boise R)
SWB 271 - Ten Mile Cr, Five Mile Cr
SWB 282 - Indian Cr (below Nampa)
SWB 10 - Snake R (King Hill - Strike Dam).
[d] Via Big Willow Cr
[e] Via Jump Cr
[f] Via Indian Cr
[g] Via New York Canal
[h] Via Reynolds Cr
[i] Via Shoofly Cr
[j] Via Little Valley Cr
[k] Via Cold Spring Cr
[l] Via L. Payette ditch
[m] F = flat; M = moderate (5-10 percent); S = Steep (>10 percent).
[n] Mistakenly identified as "Steve Drees" feedlot in aerial survey report

SOURCES: EPA 1984a; IDHW files.

Table A-3. Previously Permitted Operations in the Twin Falls Area[a]

PERMIT NUMBER	EXPIRATION DATE	NAME[b]	AREA	RECEIVING WATER	RECORDED COMPLAINTS
			PERMITTED FEEDLOTS		
002210-1	6/7/78	Albert Andersen & Sons	Oakley	Snake R (via Goose Cr)	
002313-2	6/6/78	Blincoe Farms, Inc.	Paul	Snake R	
002160-1	6/4/78	Burley Butte Custom Feedlot	Burley	Snake R	
002164-4	6/11/79	Circle V Cattle Co.	Jerome	Snake R	
002161-0	6/6/79	D. M. Ranches, Inc. (Cattle)	Paul	Snake R	
002241-1	5/4/79	D. M. Ranches, Inc. (Sheep) (Darryl Manning)	Paul	Snake R	
002230-6	6/11/78	France, Inc. (Triangle Feedlot)	Gooding	Big Wood R	
002234-9	6/11/78	Hill Inc.	Shoshone	Big Wood R	
002113-0	6/4/79	Interstate Feeders, Inc.	Malta	Snake R (via Raft R)	
002288-8	6/7/78	Jones Livestock Feed Co., Inc.	Eden	Snake R (via Goose Lk)	
002232-2	6/11/79	Lynn Manning & Sons	Paul	Snake R (via Main Drain)	
002224-1	5/28/79	Olmstead Cattle Co.	Twin Falls	Snake R (via Rock Cr)	
002296-9	6/6/79	Robert Schenk	Paul	Snake R (via unnamed canal)	
002150-3	6/4/78	Russel C. Linstrom	Paul	Snake R (via unnamed canal)	
002481-3	8/31/82	Toone Ranches	Buhl	Unnamed canal	x
002280-2	6/11/79	Uhlig Feedlots, Inc.	Hansen	Snake R (via Main Canal)	
			PERMITTED DAIRIES		
002470-8	6/2/82	R. W. Dairy, Inc.[c]	Hagerman	Snake R	x
002463-0	8/31/82	Shady Grove Dairies, Inc.	Hagerman	Billingsley Cr	x
002469-4	6/2/83	Stoker Dairy	Burley	Snake R	
002220-9	10/31/79	Simplot Industries (C & Y Farms)	Malta	Raft R	x

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[a] Identified in Volume [illegible] or 4 of the aerial survey (EPA 1984c, 1985).

[b] Names in parentheses indicate previous name or other identifying name under which information exists in IDHW files.

[c] This dairy not included on EPA permit listing because of wrong computer entry code.

SOURCES: EPA and IDHW files.

Table A-4. Confined Animal Feeding Operations Identified by Aerial Survey in the Twin Falls Area

FEEDLOTS/STOCKYARDS

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS[b]	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[d]	IMPOUNDMENTS (#, ACRES)	GENERAL LOCATION
99	Mink	3.5	51-200	USB 850	Direct access	F	None	Gooding
100	C. Adams	2.0	51-200	USB 850	Direct access	M	None	Gooding
114	J. Patterson	0.75	51-200	USB 850	?	F	None	Gooding
115	J. Patterson	13.0	>1,000	USB 850	40	F	2; 2 AC	Gooding
116	Arkoosh & Zidan	10.0	51-200	USB 850	50	F	None	Gooding
120	Wiseman	7.0	51-200	None	1,000	F	None	Gooding
121	Gooding Stockyards	14.0	<50	USB 850	30	S	None	Gooding
127	W. Fields	10.0	51-200	None	20	F	None	Gooding
132	E. Morris	5.0	201-700	Canal	Direct access	F	None	Tuttle
139	Ray Gardner	2.0	<50	USB 80	Direct access	F	None	Hagerman
142	C. Edwards	2.5	51-200	Curren Dit	285	M	None	Hagerman
143	Ernie Hegie+	9.0	--	None	4,200	M	None	Hagarman
156	Roy Vader	5.5	51-200	None	85	F	None	Hagerman
157	E. Radermacher	5.0	51-200	None	Direct access	F	None	Hagerman
166	Richard Bateman	0.5	51-200	USB 80	Direct access	F	None	Shoshone
167	Tina Iest	8.0	51-200	USB 871	Direct access	F	None	Shoshone
168	Pete Oneida	2.0	51-200	USB 850	Direct access	F	None	Shoshone
171	Jose Arrate	12.0	51-200	USB 850	270	M	None	Shoshone
174	Dale Low (Stockyard)	3.5	51-200	None	420	F	None	Shoshone
202	Howard Harder	1.0	<50	USB 80[g]	Direct access	F	None	Buhl
206	Leo Meyers	1.8	51-200	USB 80[g]	Direct access	F	None	Buhl
211	M. Guerry	17.0	51-200	USB 820	760	S	None	Buhl
229	Circle M Ranch	8.9	201-700	Lateral	50	F	None	Wendell
230	France Cattle Co. *	110.5	>1,000	None	40	F	7; 8.1 AC	Wendell
235	Larry Holtzen Cattle Co.	11.0	51-200	None	40	F	None	Jerome
253	R. Chugg Livestock	25.0	201-700	None	2,000	M	None	Jerome
254	G. C. Gould (Glendale Ranch)	5.7	51-200	None	Direct access	F	None	Buhl
256	A. S. Vickers	2.9	51-200	USB 730	440	F	None	Twin Falls
264	D. R. Cambell	7.3	201-700	Lateral?	255	M	None	Kimberley
265	E. Barnes	56.6	>1,000	T F Main C	2,050	F/M	1; 1.2 AC	Hansen
266	Uhlig Ranches*	26.9	701-1,000	T F Main C	80	F	2; 1.1 AC	Hansen
267	Butte Farms *(?)	7.5	201-700	Lateral?	5,540	M	None	Hazelton
270	Blincoe Farms Inc.*	36.5	--	B-4 Canal	40	M	2; 1.3 AC	Paul
271	R. Lindstrom*	25.3	201-700	B-4 Canal	40	F	None	Paul
272	R.L. Bryant & W.A. Eager	24.3	51-200	USB 60B	80	F/M	2; 0.3 AC	Burley
273	Moorman Ranches	17.5	--	USB 60B[f]	Direct access	M/S	None	Burley
275	J. Chisholm	45.0	--	None	20	F	None	Acequia
277	Sheep Sheo Ranches	83.9	--	USB 60A	40	F	None	Rupert
278	Oxrango	54.0	--	None	40	F	None	Rupert
279	R. Robbins	13.2	--	None	40	F	None	Rupert
281	F. Jouglard	43.8	--	None	10	F	None	Rupert
283	J. Ituarte	27.0	51-200	USB 60A	10	M	None	Rupert
289	Taylor Land Co.	24.0	--	USB 520	585	M	None	Raft River

Table A-4. Continued

FEEDLOTS/STOCKYARDS

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS[b]	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[d]	IMPOUNDMENTS (#, ACRES)	GENERAL LOCATION
290	Taylor Land Co.	10.4	--	USB 520(?)	585	F	None	Raft River
291	Howard Conrad	61.3	701-1,000	None(?)	3,165	M	1; 2.1 AC	Burley
292	V. T. Geary	2.7	701-1,000	J Canal	Direct access	F	None	Burley

DAIRIES

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS[b]	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[d]	IMPOUNDMENTS (#, ACRES)	GENERAL LOCATION
101	N. W. Rasmussen	1.5	51-200	USB 850	Direct access	F	None	Shoshone
102	A. Kerner	4.0	51-200	USB 850	Direct access	S	1; 0.3 AC	Richfield
103	G. Kerner	5.5	51-200	USB 850	Direct access	S	None	Richfield
104	Idaho Dairy Farm	7.0	51-200	USB 871[e]	40	M	2; 1.5 AC	Richfield
105	Lee Roy Parker	3.0	51-200	USB 871[e]	Direct access	M	None	Richfield
106	Ralph Riley	1.75	51-200	USB 871[e]	?	M	None	Richfield
107	R. W. Johnson	5.5	<50	USB 871	Direct access	F	2; 0.75 AC	Richfield
108	R. W. Johnson	1.5	<50	USB 871	280	F	None	Richfield
109	Cid Lesamiz+	5.0	51-200	USB 871	1,370	F	None	Richfield
110	James Powell	3.0	51-200	USB 871	Direct access	M	None	Richfield
111	Blaine Sorenson	8.0	51-200	USB 871	Direct access	F	None	Richfield
112	Rod Pridmore	3.0	51-200	USB 871	30	F	None	Richfield
113	A. R. Sumner	2.5	51-200	Canal	Direct access	F	None	Gooding
117	W. Boeslger	1.5	51-200	USB 850	Direct access	F	None	Gooding
118	A. C. Sabala	5.0	51-200	USB 850	40	F	2; 0.25 AC	Gooding
119	M. Sabala	1.0	<50	None	1,000	F	None	Gooding
122	T. Bingham	3.5	51-200	Pond	3,500	M	None	Gooding
123	R. C. Zaplicke	10.0	201-700	USB 871	190	F	None	Gooding
124	O. Leavell	24.0	51-200	None	1,850	F	2; 0.25 AC	Fuller
125	L. Graves	3.0	<50	None	800	F	None	Tuttle
126	Faulkner Land & Livestock	35.0	<50	None	10	F	None	Tuttle
128	R. Bingham	4.0	51-200	None	2,500	F	None	Gooding
129	B. Noringer	7.5	51-200	None	50	F	2; 0.5 AC	Gooding
130	F. Graves & Sons	2.5	51-200	None	1,200	F	None	Tuttle
131	G. Hooper	5.0	51-200	Canal	Direct access	F	None	Tuttle
133	Firmage Co.	10.0	51-200	Big Bend D	Direct access	F	None	Hagerman
134	G. Coleman	10.0	51-200	USB 840	Direct access	M	None	Hagerman
135	A. Schilling	2.5	51-200	None	30	F	None	Wendell
136	A. Schilling	0.5	<50	Canal	Direct access	F	None	Wendell
137	B. Hilardes	4.0	51-200	Canal	Direct access	M	None	Wendell
138	B. Hilardes	11.5	201-700	None	Direct access	M	None	Wendell
140	Buckeye Ranch	11.0	None	USB 80	40	F	None	Hagerman
141	V. I. Maveneamt	1.75	<50	Curren Dit	?	M	None	Hagerman
144	R. McCord	4.5	51-200	None	1,000	F	None	Wendell

Table A-4. Continued

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS[b]	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[d]	IMPOUNDMENTS (#, ACRES)	GENERAL LOCATION
145	Vandenburg Bros.	4.0	<50	Canal	Direct access	F	1; 0.25 AC	Wendell
146	Hill Brandsma+	3.0	51-200	Canal	40	F	2; 0.25 AC	Wendell
147	S. Goodhart	4.0	51-200	Canal	40	F	2; 0.25 AC	Wendell
146	E. Ciocca	10.0	201-700	Canal	1,450	F	1; 0.3 AC	Wendell
149	R. Mathers	4.5	51-200	Canal	200	F	None	Wendell
150	K. Tincate	7.5	51-200	Canal	200	M	None	Wendell
151	Jensen & McIntyre	10.0	<50	Canal	Direct access	M	None	Wendell
152	H. Twamley	8.0	51-200	None	660	F	None	Wendell
153	G. Bird	.5	<50	Canal	Direct access	M	None	Wendell
154	B. Andrews	1.0	51-200	None	40	F	None	Wendell
155	J. Kening	2.5	51-200	None	40	F	None	Wendell
158	H. Rictkirk	6.0	51-200	None	1,330	F	None	Wendell
159	H. Rictkirk	18.0	51-200	None	40	M	None	Wendell
160	L. Loper	6.5	51-200	None	1,125	F	None	Wendell
161	R. Van Dyke	5.0	51-200	Canal	Direct access	S	None	Wendell
162	R. Van Dyke	3.5	51-200	Canal	Direct access	M	None	Wendell
163	R. Van Dyke	23.0	201-700	Canal	830	M	None	Wendell
164	R. Neales	5.5	201-700	Canal	40	F	None	Wendell
165	Shoemaker Bros.	4.0	51-200	Canal	85	M	None	Wendell
169	William Harris	None	<50	USB 850	Direct access	M	None	Shoshone
170	Jose Arrate	1.5	<50	USB 850	Direct access	F	None	Shoshone
172	Farnsworth/Koeppen (2 dairies)	4.0	51-200	USB 850	Direct access	M	None	Shoshone
173	Alex Anchustegui	0.5	<50	USB 850	Direct access	M	None	Shoshone
175	W. Patterson	9.5	51-200	J Canal	1,100	M	None	Jerome
176	W. Patterson	4.5	51-200	None	150	F	None	Jerome
177	E. Thompson	12.0	<50	Lateral(?)	Direct access	M	None	Wendell
178	Ed. Hubbard	10.0	201-700	None	900	F	4; 6.0 AC	Wendell
179	Fox Canyon Livestock	26.0	201-700	Lateral(?)	80	F	1; 0.1 AC	Wendell
180	Pete Veenstra	10.0	51-200	Lateral(?)	20	M	2; 1.5 AC	Wendell
181	J. Dufree	3.0	51-200	None	310	F	None	Wendell
182	Dew Dufree	3.75	51-200	None	1,865	F	None	Wendell
183	E. A. Branch	10.0	51-200	None	Direct access	F	None	Wendell
184	W. Kearley	1.0	51-200	None	660	F	None	Wendell
185	R. Crosby	10.0	51-200	Lateral	125	M	None	Wendell
186	Harry Goedhart+	17.4	201-700	USB 740	325	F/M	2; 2.1 AC	Wendell
187	Flamingo Dairy	3.5	51-200	USB 70	350	F	None	Wendell
188	Jim Pearson	1.8	51-200	USB 810(?)	40	F	None	Buhl
189	T. Sertek	1.1	<50	USB 810(?)	Direct access	F	None	Buhl
190	Tom Pearson	1.5	51-200	USB 810	940	F	1; 0.25 AC	Buhl
191	Merle Engi	5.5	<50	USB 810	1,760	F	None	Buhl
192	Mike Vierstra	3.6	51-200	USB 809	600	F	1; 1.5 AC	Buhl
193	Leonard Easterday	7.8	51-200	USB 820	Direct access	F	None	Buhl
194	A. Barker	3.7	51-200	None	Direct access	F	None	Buhl
195	Howard Harder	11.1	51-200	None	Direct access	F	3; 0.9 AC	Buhl
196	Harry Bokma+	6.9	201-700	USB 820	40	F	2; 0.03 AC	Buhl
197	Harry Hoagland	15.0	51-200	USB 810	40	F	2; 2.7 AC	Buhl
198	Manuel Sausa Dairy+	1.5	51-200	USB 810	40	F	None	Buhl
199	Fred Kippas	1.0	51-200	USB 810(?)	300	F	None	Buhl
200	Mike Donahue+	4.4	51-200	USB 810(?)	55	F	2; 0.8 AC	Buhl

Table A-4. Continued

SITE NO.	NAME^{a}	FEEDING AREA (AC)	NO. ANIMALS^{b}	RECEIVING WATER^{c}	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE^{d}	IMPOUNDMENTS (#, ACRES)	GENERAL LOCATION
201	Bob Visser	1.2	<50	Low Line C	645	F	None	Buhl
203	D. Acgenback	3.4	51-200	USB 809^{g}(?)	Direct access	F	None	Buhl
204	Toone (Lone Tree)+* (abandoned)	2.8	--	USB 809^{g}(?)	235	F	2; 0.5 AC	Buhl
205	Curtis Brenden Dairy	10.0	201-700	USB 809^{g}	1,935	M	1; 0.9 AC	Buhl
207	Ken Lowman	3.0	<50	Low Line C	40	F	2; 1.8 AC	Buhl
208	John DeKruyf+	4.5	51-200	USB 809^{g}(?)	10	F	1; 1.8 AC	Buhl
209	W. Shaffer	6.3	51-200	Low Line C	920	F	None	Buhl
210	FHA Dairy (abandoned)	2.0	51-200	None	85	F	None	Buhl
212	Wells Livestock	32.7	--	USB 820	20	M	None	Buhl
213	Rick Lowman	2.8	201-700	None	425	F	2; 2.8 AC	Buhl
214	J. W. Hoogland	5.8	51-200	None	85	F	None	Buhl
215	John Schildner	9.1	51-200	USB 810	65	F	1; 0.2 AC	Bunl
216	W. J. Lammer	5.5	51-200	USB 810	20	F	None	Buhl
217	Don Bothof+	7.4	51-200	USB 810	65	F/M	2; 0.9 AC	Buhl
218	W. K. Wert	6.0	51-200	None	310	F	1; 3.5 AC	Buhl
219	B. and Z. Harrison	3.0	<50	USB 740	Direct access	F	None	Wendell
220	G. Arkoosh & Zidan	10.0	51-200	None	40	F	None	Wendell
221	Kober Farms	4.0	51-200	None	230	F	1; 1.0 AC	Wendell
222	Kober Farms	3.5	51-200	None	40	F	None	Wendell
223	Howard Meyers	18.7	201-700	None?	140	F	None	Wendell
224	L. Jones	9.3	201-700	None	1,460	S	1; 0.3 AC	Jerome
225	P. Holloway	14.0	201-700	Lateral?	Direct access	F	None	Jerome
226	H. Vander Meer	11.5	201-700	Lateral?	80	M	2; 1.5 AC	Jerome
227	D. Leerman	18.5	701-1,000	Lateral?	80	M	2; 0.8 AC	Jerome
228	Mike Vierstra	11.0	201-700	None	145	M	3; 3.0 AC	Wendell
231	Standing Hat Ranch	4.3	51-200	None	2,520	F	None	Wendell
232	Ted Miller	15.4	201-700	Lateral	650	F	3; 3.5 AC	Wendell
233	Muddler Cattle Co.	10.8	51-200	None	80	F	1; 1.0 AC	Jerome
234	W. McCaughey	2.0	51-200	None	1,300	F	None	Jerome
236	M. Bishop	2.7	51-200	None	675	F	None	Jerome
237	Calvin DeKruyf	13.2	201-700	Lateral	60	F	1; 3.5 AC	Jerome
238	Gary Bothof	7.3	51-200	Lateral	325	F	1; 1.2 AC	Jerome
239	Ted Baar (Double Dipper Dairy)+	16.5	201-700	Lateral	80	F	7; 2.8 AC	Jerome
240	L. Andressen	12.5	201-700	None	40	F	3; 1.5 AC	Jerome
241	A. Reliance	16.0	201-700	None	880	F	3; 4.0 AC	Jerome
242	H. Van Beck	16.0	201-700	None	320	F	None	Jerome
243	J. Jackson	4.7	51-200	None	60	F	None	Jerome
244	H. Vander Meer	15.9	201-700	Lateral?	640	F/M	2; 1.0 AC	Jerome
245	Bob Morris	5.0	51-200	L Canal	40	F/M	None	Jerome
246	Irene Vander Vegt+(?)	13.9	51-200	Lateral	Direct access	F	3; 2.25 AC	Jerome
247	Marion Vanden Bosch	4.7	<50	Lateral	Direct access	F	None	Jerome
248	Reisman	4.5	201-700	Lateral?	520	F/M	None	Jerome
249	J. Tolman	3.4	51-200	Lateral?	Direct access	F	1; 0.5 AC	Jerome
250	Drew Critzer •	5.9	201-700	D-5 Ditch	855	F	2; 1.8 AC	Jerome
251	V. Bishop	4.5	51-200	USB 740	Direct access	M	None	Buhl
252	Larry Vander Vegt +(?)	17.0	51-200	Lateral?	Direct access	F	1; 2.3 AC	Jerome
255	Frank Dores (abandoned)	3.2	51-200	Lateral?	Direct access	F	1; 0.6 AC	Buhl
257	A. Drolaw	5.8	51-200	Lateral	850	F	None	Filer
258	Robert and Dale Sandigar	6.8	51-200	USB 740^{f}	20	F	2; 0.5 AC	Filer

Table A-4. Continued

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS[b]	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[d]	IMPOUNDMENTS (#, ACRES)	GENERAL LOCATION
259	Stan Nunes Dairy	8.0	51-200	USB 740[f]	Direct access	M	None	Filer
260	J. Hoogland (formerly Alneida)	5.8	51-200	Low Line C	Direct access	F	3; 2.1 AC	Filer
261	Clyde Wright	3.3	51-200	Low Line C	Direct access	F	None	Filer
262	Classic Dairy (Bud Vierstra)+(?)	10.8	201-700	USB 730[f]	40	F	2; 3.0 AC	Twin Falls
263	Rosco Wagner	3.0	<50	USB 730	85	S	None	Twin Falls
268	G. Stoker +(?)	13.5	--	None	20	M/S	None	Rupert
269	Darryl Manning*	14.8	201-700	None	40	F	None	Paul
274	K. and J. Hayden	4.5	51-200	None	30	F	None	Acequia
276	Walcott Ranches	5.2	51-200	Lateral?	40	M	None	Acequia
280	Ivan Haskel	8.4	51-200	Main S C	Direct access	M	None	Rupert
282	Barbara Studer	5.1	51-200	A Canal	20	F	None	Rupert
284	E. Lind	5.2	201-700	Main S C	Direct access	F	3; 0.4 AC	Declo
285	A. Brim	3.6	51-200	None	165	F	1; 0.2 AC	Raft River
286	L. Funk (Riviera Farms, Inc.)	5.5	51-200	USB 520	160	S	None	Raft River
287	C. H. Hisaw	1.9	51-200	None	180	F	1; 0.4 AC	Raft River
288	Simplot Industries*	26.0	>1,000	Lateral?	Direct access	F/M	3; 4.0 AC	Raft River
293	R. Garrett+	5.2	51-200	Snipe Gul	20	F	3; 3.0 AC	Burley
294	S. Alred	1.0	51-200	None	Direct access	F	None	Burley
295	R. D. Zollinger	4.5	51-200	USB 60A[h]	Direct access	M	1; 0.1 AC	Burley
296	C. Williams	12.3	51-200	None	450	F	None	Burley
297	M. Payne	4.9	51-200	H Canal	1,300	F	1; 0.1 AC	Burley
298	F. Robinson	7.8	51-200	H Canal	20	F	None	Burley

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[a] * = Permitted; + = Water quality complaint received by IDHW.

[b] It should be noted that number of animals may vary substantially depending on time of year.

[c] USB 80 - Snake R (Buhl - King Hill)
USB 810 - Deep Cr (Source - mouth)
USB 820 - Salmon Falls Cr (ID/NV border - mouth)
USB 840 - Billingsley Cr (Source - mouth)
USB 850 - Big Wood R (Source - Magic Res)
USB 871 - Little Wood R (Source - Richfield)
USB 70 - Snake R (Milner Dam - Buhl)
USB 730 - Rock Cr (City - mouth)
USB 740 - Cedar Draw Cr (Source - mouth)
USB 60A - Snake R (Minidoka Dam - Heyburn/Burley Bridge)
USB 60B - Snake R (Heyburn/Burley Bridge - Milner Dam)
USB 520 - Raft R (Source - mouth)

[d] F = Flat; M = Moderate (5-10 percent); S = Steep (>10 percent)

[e] Via Jim Burns Slough

[f] Via lateral

[g] Via Mud Cr

[h] Via Duck Cr

SOURCES: EPA 1984b; EPA 1985; Morrison pers. comm.

Table A-5. Previously Permitted Operations in the Blackfoot Area

PERMIT NUMBER	EXPIRATION DATE	NAME[a]	AREA	RECEIVING WATER	RECORDED COMPLAINTS
			PERMITTED FEEDLOTS		
002298-5	6/13/79	Arnold Feedlot	Idaho Falls	Snake R (via Sand Cr)	
002187-3	6/4/79	*Clement Brothers Livestock (Lyle Taylor)	Menan	Snake R	
002291-8	6/13/79	Hyer Cattle Co.	Shelley	Snake R	
002227-6	6/11/79	*Harris-Idaho, Inc. (Harding Livestock & Land)	Blackfoot	Snake R	
002186-5	5/28/79	Lenard A. Schritter Feedlot	Aberdeen	Snake R	
002226-8	6/4/79	*Louis Skaar and Sons, Inc.	Roberts	Snake R	
002117-2	6/4/79	*Meyers Brothers Feedlots, Inc.	Sugar City	N Fork Teton R	
002140-7	5/28/79	*Sand Ridge Feeding Co.	Blackfoot	Blackfoot R	
002171-7	5/28/79	*Snake River Cattle Co., Inc.	American Falls	Snake R	
002221-7	6/4/79	*Spur Cattle Co.	Roberts	Snake R	
			PERMITTED DAIRIES		
			- 0 -		

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* Identified in Volume 2 of the aerial survey (EPA 1984b).

[a] Names in parentheses indicate previous name or other identifying name under which information exists in IDWH files.

SOURCES: EPA and IDHW files.

Table A-6. Confined Animal Feeding Operations Identified by Aerial Survey in the Blackfoot Area

FEEDLOTS/SHEEP RAISING

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[b]	IMPOUNDMENTS (#/ACRES)	LOCATION
32	Meyers Brothers Feedlots, Inc.*	26	>1000	Canal	None/20	F	2; 1.3 AC	Sugar City
34	Hoaghland Farms	1.7	<50	None	Direct access	F	None	Menan
36	Clement Brothers Livestock*+	16	201-700	USB 30	Direct access	F	4; 5 AC	Menan
37	Spur Cattle Co.*	50	701-1000	USB 30	Direct access	F	10; 28 AC	Lewisville
38	Harris-Idaho, Inc.*	47	>1000	None	None/215	F	10; 13 AC	Moreland
39	Sand Ridge Feeding Co.*	1.1	51-200	None	None/1400	F	None	Blackfoot
40	Beck Feedlot	10	201-700	USB 40	None/130	F	4; 1.5 AC	Aberdeen
41	Wan Iregogen	1.0	201-700	Lat. C.	None/10	F	None	Aberdeen
44	Albert Horsh	3	<50	None	None/20	F	None	Aberdeen
45	Ferrel Palmer	3.1	51-200	None	None/1750	F	None	Aberdeen
46	Morgan Anderson	[illegible].0	201-700	None	None/105	M	None	Aberdeen
47	Clarence Schroeder	3.5	201-700	None	Direct access	M	None	Fairview
48	Clarence Schroeder	2.0	201-700	H.L. C.	Direct access	F	None	Fairview
50	Snake River Cattle Co., Inc.*	90	>1000	None	None/1970	F	12; 7.2 AC	Am. Falls
51	Roger Whitnak	6	201-700	None	Direct access	M	None	Borah
52	------------	3	51-200	USB 411	Direct access	F	1; 0.2 AC	McCammon
55	David Harris	2	None	BB 471	Direct access	F	None	Malad City
56	Morgan Harris	7	None	BB 471	Direct access	M	None	Malad City
57	Morgan Harris	3	None	BB 471	Direct access	S	None	Malad City
58	Curtigan Brothers	5.2	51-200	Devils Cr	Direct access	F/M	None	Malad City
59	F. M. Deschamps	9.3	51-200	Unnamed	Direct access	M/S	None	Malad City
60	Ferron Burke	2	<50	BB 30[d]	Direct access	M	None	Lago
61	Ferron Burke	12	201-700	BB 30[d]	Direct access	F/S	1; 0.3 AC	Lago
62	Charles Izatt	3.3	51-200	BB 30[e]	Direct access	F	None	Lago
63	Dick Smith	1.5	<50	BB 30[e]	Direct access	M	None	Lago
66	Valero Bennett	0.5	None	BB 30[d]	Direct access	F	None	Lago
67	Floyd Toone	2	<50	BB 30[d]	Direct access	F	None	Lago
75	------------	1.4	<50	BB 30[d]	Direct access	F	None	Thatcher
76	------------	1	None	BB 30[d]	Direct access	F	None	Thatcher
80	Rockwood	0.5	<50	BB 410	Direct access	M	None	Mink Cr.
81	Christenson	2.8	<50	BB 410	Direct access	F/S	None	Mink Cr.
84	Bert Wheatley	1.3	51-200	BB 430	Direct access	F/S	None	Preston
85	Monty Moser	0.3	51-200	BB 430	Direct access	F	None	Preston
88	Lloyd Christensen	1.7	<50	BB 450	None/10	F	None	Franklin

DAIRIES

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[b]	IMPOUNDMENTS (#/ACRES)	LOCATION
33	Hoaghland Farms	1	51-200	None	None/25	F	None	Sugar City
35	L. Skaar & Sons*	0.75	51-200	None	None/15	F	None	Menan
42	William Lehman	3	51-200	H.L. C.	Direct access	M	None	Aberdeen
43	Otto Klasen	1.5	51-200	None	Direct access	F	None	Aberdeen
49	Robert Shroeder	0.75	51-200	H.L. C.	Direct access	M	None	Fairview
53	------------	4.5	51-200	USB 411[g]	None/30	F	None	McCammon
54	------------	2.1	<50	USB 411[g]	Direct access	M	None	McCammon

Table A-6. Continued

SITE NO.	NAME[a]	FEEDING AREA (AC)	NO. ANIMALS	RECEIVING WATER[c]	ANIMAL ACCESS/ PEN DISTANCE TO WATERWAY (FT)	SLOPE[b]	IMPOUNDMENTS (#/ACRES)	LOCATION
64	Trout Creek Dairy	6	51-200	BB 30[d]	Direct access	F	None	Lago
65	Allen Rudd	1	<50	BB 30[d]	Direct access	F	None	Lago
68	Horace Wright	1	51-200	BB 30[e]	None/30	F	None	Lago
69	Marvin Prescott	1	<50	BB 30	None/1800	M	None	Lago
70	Harris Mickelson	0.5	51-200	BB 30[d]	None/145	F	None	Lago
71	Clark Mickelson	0.5	<50	BB 30[d]	None/240	F	1; 0.7 AC	Lago
72	Daniel Mickelson	2.5	51-200	BB 30[d]	Direct access	F	None	Lago
73	Elvin Hubbard	1.5	51-200	BB 30[f]	Direct access	M	None	Thatcher
74	Lynn Turner	3	<50	Canal	None/35	S	None	Thatcher
77	Christenson	1.5	51-200	BB 410	Direct access	S	None	Mink Cr.
78	Christenson	3	51-200	BB 410	None/10	M	None	Mink Cr.
79	Christenson	4.5	51-200	BB 410	Direct access	F	None	Mink Cr.
82	Bob Landhardt	0.5	<50	BB 430	Direct access	F/S	None	Preston
83	Erickson Brothers	0.5	51-200	None	None/115	F	1; 0.2 AC	Preston
86	Gayle Moser	1.6	51-200	BB 430	None/10	F	None	Preston
87	Lloyd Christensen	1.3	<50	BB 450	None/10	F	None	Franklin
89	Lloyd Christensen	1.3	<50	BB 450	Direct access	F	None	Franklin
90	Lloyd Christensen	0.5	<50	BB 450	None/55	M	None	Franklin
91	------------	0.6	51-200	BB 450	Direct access	F	1; 1 AC	Franklin
92	------------	0.6	<50	Cub C.	None/385	F	None	Franklin
93	Stanton Hawkes	3.1	201-700	BB 450	Direct access	F	None	Franklin
94	Kenneth Hawkes	0.2	<50	BB 450	None/220	F	None	Franklin
95	Walter Knapp	2.4	<50	BB 450	None/935	F	None	Franklin
96	William Wright	7.5	51-200	BB 450	Direct access	F	None	Franklin
97	William Wright	1.4	51-200	Unnamed	Direct access	F	None	Franklin
98	William Wright	3.7	51-200	None	None/90	F	None	Franklin

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[a] + = Slaughterhouse; * = Permitted.
[b] F = Flat; M = Moderate; S = Steep.
[c] USB 30 - Snake R (Roberts - Am. Falls Res.)
USB 40 - Snake R (Am. Falls Res.)
USB 411 - Marsh Cr (Source - mouth)
BB 471 - Little Malad R (Source - mouth)
BB 410 - Mink Cr (Source - mouth)
BB 430 - Worm Cr (Source - ID/UT border)
BB 450A - Cub R (Mapleton - Franklin)
BB 30 - Bear R (Soda Sp. - UPL Tailrace)
[d] Via Trout Cr
[e] Via Whiskey Cr
[f] Via Burton Cr
[g] Via Unnamed stream

SOURCE: EPA 1984c and Morrison, pers. comm.

APPENDIX B

Waste Characteristics

Table B-1. Beef Cattle: Dirt-Moderate Slope-Runoff

Parameter	kg/head/cm runoff (lb/head/inch runoff)			mg/l		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Total (wet solids)	-	186.16 (1040.0)	-	-	-	-
Moisture	183.40 (1024.4)	184.67 (1031.7)	185.16 (1034.4)	985,000	992,000	994,000
Dry Solids	1.11 6.24	1.49 (8.32)	2.79 (15.0)	6,000	8,000	15,000
Volatile Solids	0.707 (3.95)	0.745 (4.16)	1.49 (8.32)	3,800	4,000	8,000
Suspended Solids	0.186 (1.04)	0.47 (2.6)	0.931 (5.20)	1,000	2,500	5,000
pH	5.1	7.6	9.4			
BOD5	0.186 (1.04)	0.279 (1.56)	1.12 (6.23)	1,000	1,500	5,000
COD	0.558 (3.12)	0.652 (3.64)	5.58 (31.2)	3,000	3,500	20,000
Ash	0.372 (2.08)	0.782 (4.37)	1.4 (7.8)	2,000	4,200	7,500
Total Nitrogen	0.004 (0.02)	0.029 (0.16)	0.204 (0.14)	20	150	1,100
Ammonia Nitrogen	0	0.01 (0.06)	0.093 (0.52)	0	60	500
Nitrate Nitrogen	0	0.005 (0.03)	0.022 (0.123)	0	25	120
Total Phosphorus	0.002 (0.01)	0.01 (0.08)	0.039 (0.22)	14	80	200
Total Potassium	0.004 (0.02)	0.063 (0.35)	0.2 (0.9)	20	340	900
Magnesium	0.01 (0.07)	0.018 (0.10)	0.021 (0.12)	70	95	120
Sodium	0.01 (0.07)	0.043 (0.24)	0.1 (0.7)	65	230	700

Animal Weight: 360 kg average (800 lbs average).
Area: 18.6 meter sq/head (200 ft sq/head).

SOURCE: EPA 1974.

Table B-2. Beef Cattle: Dirt-Steep Slope-Runoff

Parameter	kg/head/cm runoff (lb/head/inch runoff)			mg/l		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Total (wet solids)	-	214.08 (1196.0)	-	-	-	-
Moisture	210.0 (1175.0)	212.29 (1186.0)	213.01 (1190.0)	982,750	990,800	990,800
Dry Solids	1.67 (9.33)	1.71 (9.57)	3.20 (17.9)	9,200	9,200	17,250
Volatile Solids	0.813 (4.54)	0.856 (4.78)	1.71 (9.57)	4,370	4,600	9,200
Suspended Solids	0.215 (1.20)	0.535 (2.99)	1.07 (5.98)	1,150	2,875	5,750
pH	5.1	7.6	9.4			
BOD5	0.215 (1.20)	0.320 (1.79)	1.29 (7.18)	1,150	1,725	5,750
COD	0.643 (3.59)	0.750 (4.19)	6.43 (35.9)	3,450	4,025	23,000
Ash	0.428 (2.39)	0.900 (5.03)	1.61 (8.97)	2,300	4,830	8,625
Total Nitrogen	0.0041 (0.023)	0.0329 (0.184)	0.234 (1.31)	23	173	1,265
Ammonia Nitrogen	0	0.012 (0.069)	0.107 (0.598)	0	69	575
Nitrate Nitrogen	0	0.00474 (0.0265)	0.00618 (0.0345)	0	29	138
Total Phosphorus	0.00206 (0.0115)	0.0185 (0.104)	0.0453 (0.253)	16	92	230
Total Potassium	0.00412 (0.0230)	0.0721 (0.403)	0.186 (1.04)	23	391	1,035
Magnesium	0.0144 (0.0805)	0.0206 (0.115)	0.0247 (0.138)	81	109	138
Sodium	0.0144 (0.0805)	0.0494 (0.276)	0.144 (0.805)	75	265	805

Animal Weight: 360 kg average (800 lbs average).
Area: 18.6 meter sq/head (200 ft sq/head).

SOURCE: EPA 1974.

Table B-3. Beef Cattle: Paved Lot-Runoff

Parameter	kg/head/inch runoff (lb/head/inch runoff)			mg/l		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Total (wet solids)	-	46.54 (260.0)	-	-	-	-
Moisture	45.795 (255.88)	45.982 (255.84)	45.61 (254.8)	980,000	984,000	988,000
Dry Solids	0.569 (3.18)	0.745 (4.16)	0.93 (5.2)	12,000	20,000	160,000
Volatile Solids	0.279 (1.56)	0.387 (2.16)	5.93 (3.12)	6,000	8,300	12,000
Suspended Solids	0.093 (0.52)	0.279 (1.56)	0.47 (2.6)	2,000	6,000	10,000
pH	5.5	6.6	7.5			
BOD_5	0.093 (0.52)	0.15 (0.83)	0.558 (3.12)	2,000	3,200	12,000
COD	0.23 (13.)	0.331 (1.85)	1.86 (10.4)	5,000	7,100	40,000
Ash	0.186 (1.04)	0.358 (2.00)	0.70 (3.9)	4,000	7,700	15,000
Total Nitrogen	0.02 (0.1)	0.052 (0.29)	0.073 (0.41)	370	1,100	1,580
Ammonia Nitrogen	0.0047 (0.026)	0.01 (0.08)	0.023 (0.13)	100	325	500
Nitrate Nitrogen	0	0.02 (0.09)	0.0558 (0.312)	0	360	1,200
Total Phosphorus	0.002 (0.01)	0.005 (0.03)	0.01 (0.08)	20	110	305
Total Potassium	0.002 (0.01)	0.02 (0.09)	0.075 (0.42)	30	350	1,600
Magnesium	0.004 (0.02)	0.005 (0.03)	0.007 (0.04)	80	100	140
Sodium	0.005 (0.03)	0.021 (0.12)	0.045 (0.25)	120	450	950

Animal Weight: 360 kg average (800 lbs average).
Area: 4.6 meter sq/head (50 ft sq/head).

SOURCE: EPA 1974.

Table B-4. Beef Cattle: Slotted Floor-Deep Pit Manure

Parameter	kg/head/day (lb/head/day)		
	Minimum	Average	Maximum
Total (wet solids)	No Data	19.6e (43.2e)	29.1e (64.0e)
Moisture	No Data	16.7e (36.7e)	25.3e (55.7e)
Dry Solids	1.0e (2.3e)	3.0e (6.5e)	5.81e (12.8e)
Volatile Solids	0.82e (1.8e)	1.6e (3.5e)	3.2e (7.0e)
ph	5.1e	5.8e	7.6e
BOD_5	0.2e (0.5e)	0.3e (0.6e)	0.73e (1.6e)
COD	0.91e (2.0e)	1.1e (2.4e)	2.0e (4.4e)
Ash	0.2e (0.5e)	0.95e (2.1e)	1.3e (2.8e)
Total Nitrogen	0.03e (0.07e)	0.11e (0.25e)	0.1e (0.3e)
Ammonia Nitrogen	0e	0.04e (0.09e)	0.05e (0.12e)
Nitrate Nitrogen	No Data	No Data	0.02e (0.04e)
Total Phosphorus	0.02e (0.05e)	0.03e (0.07e)	0.03e (0.07e)
Total Potassium	0.03e (0.07e)	0.08e (0.19e)	0.09e (0.02e)
Magnesium	0.009e (0.02e)	0.02e (0.04e)	0.020e (0.045e)
Sodium	0.01e (0.03e)	0.04e (0.09e)	0.082e (0.18e)
Diethylstilbestrol	0e	0e	Trace

e - estimate
Animal weight: 360 kg average (800 lbs average).

SOURCE: EPA 1974.

Table B-5. Beef Cattle: Fresh Manure-Slotted Floor/ Shallow Pit Manure

	kg/head/day (lb/head/day)		
Parameter	Minimum	Average	Maximum
Total (wet solids)	18.2 (40.0)	21.8 (48.0)	29.1 (64.0)
Moisture	14.5 (32.0)	18.5 (40.8)	25.3 (55.7)
Dry Solids	1.9 (4.3)	3.3 (7.2)	5.81 (12.8)
Volatile Solids	1.4 (3.0)	2.6 (5.8)	3.2 (7.0)
pH	7.2	7.3	7.6
BOD_5	0.4 (0.8)	0.45 (1.0)	0.73 (1.6)
COD	0.73 (1.6)	1.6 (3.5)	2.0 (4.4)
Ash	0.59 (1.3)	0.77 (1.7)	1.3 (2.8)
Total Nitrogen	0.073 (0.16)	0.12 (0.263)	0.14 (0.307)
Ammonia Nitrogen	0.03 (0.07)	0.04 (0.08)	0.04 (0.09)
Nitrate Nitrogen	0.01 (0.03)	0.017 (0.038)	0.02 (0.04)
Total Phosphorus	0.03 (0.06)	0.031 (0.068)	0.03 (0.07)
Total Potassium	0.073 (0.016)	0.0831 (0.183)	0.091 (0.20)
Magnesium	0.018 (0.039)	0.0192 (0.0192)	0.020 (0.020)
Sodium	0.02 (0.05)	0.0365 (0.0803)	0.082 (0.18)
Diethylstilbestrol	-	-	Trace

Animal weight: 360 kg average (800 lbs average).

SOURCE: EPA 1974.

Table B-6. Beef Cattle: Housed-Solid Floor-Manure and Bedding

Parameter	kg/head/day (lb/head/day)		
	Minimum	Average	Maximum
Total (wet solids)	5.77e (12.7e)	7.63e (16.8e)	20.2e (44.4e)
Moisture	2.6e (5.7e)	3.8e (8.4e)	16.5e (36.4e)
Dry Solids	3.2e (7.0e)	3.8e (8.4e)	9.08e (20.0e)
Volatile Solids	1.6e (3.5e)	1.8e (4.0e)	2.5e (5.5e)
pH	No Data	7.3e	No Data
BOD_5	No Data	0.4e (0.7e)	No Data
COD	No Data	1.1e (2.5e)	No Data
Ash	No Data	2.0e (4.4e)	No Data
Total Nitrogen	No Data	0.082e (0.18e)	No Data
Ammonia Nitrogen	No Data	0.03e (0.07e)	No Data
Nitrate Nitrogen	No Data	0.01e (0.03e)	No Data
Total Phosphorus	No Data	0.031 (0.068e)	No Data
Total Potassium	No Data	0.183e (0.183e)	No Data
Magnesium	No Data	0.019e (0.042e)	No Data
Sodium	No Data	0.04e (0.08e)	No Data

e - estimate
Animal weight: 360 kg average (800 lbs average).

SOURCE: EPA 1974.

Table B-7. Dairy Cattle: Cow Yard-Runoff

Parameter	kg/head/cm Runoff (lb/head/inch runoff)			mg/l		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Total (wet solids)	No Data	186e (1040e)	No Data	-	-	-
Moisture	"	184.67e (10317e)	"	No Data	992,000e	No Data
Dry Solids	"	1.49e (8.32e)	"	-	8,000e	"
Volatile Solids	"	0.707e (3.95e)	"	"	4,000e	"
Suspended Solids	"	No Data	"	"	No Data	"
pH	"	"	"			
BOD_5	"	0.279e (1.56e)	"	No Data	1,500e	No Data
COD	"	0.652e (3.64e)	"	"	3,500e	"
Ash	"	0.782e (4.37e)	"	-	No Data	"
Total Nitrogen	"	0.029e (0.16e)	"	-	150e	"
Ammonia Nitrogen	"	No Data	"	-	No Data	"
Nitrate Nitrogen	"	"	"	"	-	"
Total Phosphorus	"	0.01e (0.08e)	"	"	80e	"
Total Potassium	"	0.063e (0.35e)	"	"	340e	"
Magnesium	"	No Data	"	"	No Data	"
Sodium	"	"	"	"	"	"

e - estimate
Animal weight: 590 kg average (1,300 lbs average).
Area: 18.6 meter sq/head (200 ft sq/head).

SOURCE: EPA 1974.

Table B-8. Dairy Cattle: Free Stall Barn-Manure and Bedding

Parameter	kg/head/day (lb/head/day)		
	Minimum	Average	Maximum
Total (wet solids)	36.7 (80.9)	42.9 (94.5)	52.2 (115)
Moisture	27.8 (61.3)	34.7 (76.4)	47.2 (104)
Dry Solids	4.1 (9.0)	8.2 (18)	14.3 (31.5)
Volatile Solids	3.39 (7.47)	6.95 (15.3)	13.1 (28.8)
pH	5	7	9
BOD_5	0.776 (1.71)	0.899 (1.98)	1.23 (2.71)
COD	3.27 (7.20)	5.72 (12.6)	12.3 (27.1)
Ash	0.286 (0.629)	0.695 (1.53)	1.43 (3.15)
Total Nitrogen	0.143 (0.314)	0.225 (0.495)	0.327 (0.720)
Ammonia Nitrogen	0.041 (0.090)	0.138 (0.305)	0.245 (0.540)
Nitrate Nitrogen	0	0.082 (0.18)	0.16 (0.36)
Total Phosphorus	0.033 (0.072)	0.041 (0.090)	0.16 (0.36)
Total Potassium	0.0695 (0.153)	0.143 (0.315)	0.266 (0.585)
Magnesium	0.041 (0.090)	0.0490 (0.108)	0.0572 (0.126)
Sodium	No Data	No Data	No Data

Animal weight: 590 kg average (1,300 lbs average).
Percent confined: 90.

SOURCE: EPA 1974.

Table B-9. Dairy Cattle: Stall Barn-Manure and Bedding

Parameter	kg/head/day (lb/head/day)		
	Minimum	Average	Maximum
Total (wet solids)	18.8 (41.4)	21.9 (48.3)	26.5 (58.4)
Moisture	14.2 (31.3)	(17.8 (39.1)	24.0 (52.9)
Dry Solids	2.1 (4.6)	4.2 (9.2)	7.31 (16.1)
Volatile Solids	1.73 (3.82)	3.55 (7.82)	6.67 (14.7)
pH	5	7	9
BOD5	0.0396 (0.873)	0.459 (1.01)	0.627 (1.38)
COD	1.67 (3.68)	2.92 (6.44)	6.27 (13.8)
Ash	0.146 (0.322)	0.355 (0.782)	0.731 (1.61)
Total Nitrogen	0.0749 (0.165)	(0.115 (0.253)	0.167 (0.368)
Ammonia Nitrogen	0.021 (0.046)	0.0708 (0.156)	0.125 (0.276)
Nitrate Nitrogen	0	0.042 (0.092)	0.0835 (0.184)
Total Phosphorus	0.0167 (0.368)	0.021 (0.046)	0.0835 (0.184)
Total Potassium	0.021 (0.046)	0.0731 (0.161)	0.136 (0.299)
Magnesium	0.021 (0.046)	0.0251 (0.0552)	0.0292 (0.0644)
Sodium	No Data	No Data	No Data

Animal weight: 590 kg average (1,300 lbs average).
Percent confined: 46.

SOURCE: EPA 1974.

Table B-10. Dairy Cattle: Free Stall Barn-Liquid Flush

Parameter	kg/head/day (lb/head/day)		
	Minimum	Average	Maximum
Total (wet Solids)	No Data	284.6e (626.0e)	No Data
Moisture	"	279.2e (615.0e)	"
Dry Solids	"	5.162 (11.37)	"
Volatile Solids	"	No Data	"
pH	"	"	"
BOD_5	"	0.885 (1.95)	"
COD	"	No Data	"
Ash	"	"	"
Total Nitrogen	"	0.228 (0.503)	"
Ammonia Nitrogen	"	0.138 (0.304)	"
Nitrate Nitrogen	"	No Data	"
Total Phosphorus	"	"	"
Total Potassium	"	"	"
Magnesium	"	"	"
Sodium	"	"	"

e - estimate
Animal weight: 590 kg average (1,300 lbs average).
Percent confined: 100.

SOURCE: EPA 1974.

Table B-11. Dairy Cattle: Free Stall Barn-Liquid Storage-Slotted Floor

Parameter	kg/head/day (lb/head/day)		
	Minimum	Average	Maximum
Total (wet solids)	No Data	43.5 (95.8)	No Data
Moisture	"	38.3 (84.4)	"
Dry Solids	"	5.162 (11.37)	"
Volatile Solids	"	No Data	"
pH	"	"	"
BOD_5	"	0.885 (1.95)	"
COD	"	No Data	"
Ash	"	"	"
Total Nitrogen	"	0.228 (0.503)	"
Ammonia Nitrogen	"	0.0627 (0.304)	"
Nitrate Nitrogen	"	"	"
Total Phosphorus	"	"	"
Total Potassium	"	"	"
Magnesium	"	"	"
Sodium	"	"	"

Animal weight: 590 kg average (1,300 lbs average).
Percent confined: 100.

SOURCE: EPA 1974.

Table B-12. Dairy Cattle: Cow Yard-Yard Manure

Parameter	kg/head/day (lb/head/day)		
	Minimum	Average	Maximum
Total (wet solids)	No Data	5.897e (12.99e)	No Data
Moisture	"	1.67e (3.67e)	"
Dry Solids	"	4.23e (9.32e)	"
Volatile Solids	"	2.92e (6.43e)	"
pH	"	No Data	"
BOD_5	"	0.499e (1.10e)	"
COD	"	1.77e (3.90e)	"
Ash	"	1.31e (2.89e)	"
Total Nitrogen	"	0.133e (0.292e)	"
Ammonia Nitrogen	"	No Data	"
Nitrate Nitrogen	"	"	"
Total Phosphorus	"	0.063e (0.140e)	" "
Total Potassium	"	0.095e (0.211e)	"
Magnesium	"	No Data	"
Sodium	"	"	"

e - estimate
Animal weight: 590 kg average (1,300 lbs average).

SOURCE: EPA 1974.

Table B-13. Dairy Cattle: Cow Yard-Milking Center Waste

Parameter	kg/head/day (lb/head/day)			mg/l		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Total (wet solids)	No Data	38.1 (84.0)	No Data	-	-	-
Moisture	"	37.8 (83.2)	"	No Data	990,500	No Data
Dry Solids	"	0.4 (0.8)	"	"	9,530	"
Volatile Solids	"	No Data	"	"	No Data	"
Suspended Solids	"	0.10 (0.22)	"	"	2,620	"
pH	"	8.0	"			
BOD_5	"	0.17 (0.38)	"	No Data	4,530	No Data
COD	"	No Data	"	"	No Data	"
Ash	"	"	"	"	"	"
Total Nitrogen	"	0.068 (0.15)	"	"	1,790	"
Ammonia Nitrogen	"	0.02 (0.05)	"	"	596	"
Nitrate Nitrogen	"	No Data	"	"	No Data	"
Total Phosphorus	"	0.0068 (0.015)	"	"	179	"
Total Potassium	"	No Data	"	"	No Data	"
Magnesium	"	"	"	"	"	"
Sodium	"	"	"	"	"	"

Animal weight: 590 kg average (1,300 lbs average).

SOURCE: EPA 1974.

Table B-14. Dairy Cattle: Free Stall Barn-Milking Center Waste

	kg/head/day (lb/head/day)			mg/l		
Parameter	Minimum	Average	Maximum	Minimum	Average	Maximum
Total (wet solids)	No Data	15.3 (33.6)	No Data	-	-	-
Moisture	"	15.2 (33.4)	"	No Data	995,000	No Data
Dry Solids	"	0.077 (0.17)	"	"	5,060	"
Volatile Solids	"	No Data	"	"	No Data	"
Suspended Solids	"	0.04 (0.08)	"	"	2,380	"
pH	"	8.0	"	"	No Data	"
BOD_5	"	0.059 (0.13)	"	No Data	3,870	No Data
COD	"	No Data	"	"	No Data	"
Ash	"	No Data	"	"	No Data	"
Total Nitrogen	"	0.0068 (0.015)	"	"	446	"
Ammonia Nitrogen	"	0.0020 (0.0044)	"	"	131	"
Nitrate Nitrogen	"	No Data	"	"	No Data	"
Total Phosphorus	"	0.0009 (0.002)	"	"	60	"
Total Potassium	"	No Data	"	"	No Data	"
Magnesium	"	"	"	"	"	"
Sodium	"	"	"	"	"	"

Animal weight: 590 kg average (1,300 lbs average).

SOURCE: EPA 1974.

Table B-15. Dairy Cattle: Stall Barn-Milk Room Waste

Parameter	kg/head/day (lb/head/day)			mg/l		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Total (wet solids)	No Data	7.63 (16.8)	No Data	-	-	-
Moisture	"	7.54 (16.6)	"	No Data	988,000	No Data
Dry Solids	"	0.059 (0.13)	"	"	7,740	"
Volatile Solids	"	No Data	"	"	No Data	"
Suspended Solids	"	0.005 (0.01)	"	"	595	"
pH	"	8.0	"	-	-	-
BOD5	"	0.005 (0.01)	"	No Data	595	No Data
COD	"	No Data	"	"	No Data	"
Ash	"	"	"	"	"	"
Total Nitrogen	"	0.00077 (0.0017)	"	"	101	"
Ammonia Nitrogen	"	0.000039 (0.000085)	"	"	5	"
Nitrate Nitrogen	"	No Data	"	"	No Data	"
Total Phosphorus	"	0.000064 (0.00014)	"	"	8	"
Total Potassium	"	No Data	"	"	No Data	"
Magnesium	"	"	"	"	"	"
Sodium	"	"	"	"	"	"

Animal weight: 590 kg average (1,300 lbs average).

SOURCE: EPA 1974.

APPENDIX C

Climatological Information

Table 3-1. Selected Temperature Data for Southern Idaho

BOISE AREA

	Averages, °F			# of Days	
	Monthly	Daily Max	Daily Min	Max Temp 32° and Below	Min Temp 32° and Below
Jan	29.9	37.1	22.6	10	26
Feb	36.1	44.3	27.9	3	21
Mar	41.4	51.8	30.9	*	18
Apr	48.6	60.8	36.4	0	8
May	57.4	70.8	44.0	0	2
Jun	65.8	79.8	51.8	0	0
Jul	74.6	90.6	58.5	0	0
Aug	72.0	87.3	56.7	0	0
Sept	63.2	77.6	48.7	0	*
Oct	51.9	64.6	39.1	0	5
Nov	39.7	49.0	30.5	1	18
Dec	32.0	39.3	24.6	6	25
Average Year				19	123

TWIN FALLS AREA

	Averages, °F			# of Days	
	Monthly	Daily Max	Daily Min	Max Temp 32° and Below	Min Temp 32° and Below
Jan	29.4	38.2	20.6	7	27
Feb	34.4	44.2	24.6	3	24
Mar	39.3	51.1	27.4	0	24
Apr	47.6	61.1	34.0	0	13
May	57.0	71.5	42.4	0	2
June	64.5	79.8	49.1	0	0
July	72.7	90.4	55.0	0	0
Aug	70.4	88.1	52.7	0	0
Sept	60.5	77.6	43.4	0	2
Oct	50.0	65.5	34.6	0	12
Nov	38.8	49.9	27.7	1	22
Dec	30.8	39.5	22.0	6	28
Average Year				17	154

POCATELLO AREA

	Averages, °F			# of Days	
	Monthly	Daily Max	Daily Min	Max Temp 32° and Below	Min Temp 32° and Below
Jan	23.8	32.4	15.1	13	27
Feb	29.5	38.6	20.4	7	25
Mar	35.5	45.8	25.2	2	26
Apr	44.6	56.8	32.3	*	17
May	54.0	67.7	40.3	0	5
June	62.5	77.6	47.3	0	*
July	71.2	88.6	53.8	0	0
Aug	68.9	86.0	51.7	0	*
Sept	59.2	75.7	42.7	0	3
Oct	48.1	62.8	33.3	*	15
Nov	35.2	45.6	24.8	4	23
Dec	26.6	35.3	17.9	12	27
Average Year				38	169

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* Less than one-half

SOURCE: NOAA 1983a, b, and 1976

Table 3-2. Selected Precipitation Data for Southern Idaho

BOISE AREA

	Water Equivalent, inches			Snowfall, inches		
	Monthly Average	Max Month	24 Hr Record	Monthly Average	Max Month	24 Hr Record
Jan	1.64	3.87	1.48	7.3	21.4	8.5
Feb	1.07	2.62	1.00	3.7	25.2	13.0
Mar	1.03	2.76	1.65	1.9	11.9	6.4
Apr	1.19	3.04	1.27	0.7	8.0	7.2
May	1.21	4.00	1.51	0.1	4.0	4.0
Jun	0.95	3.41	2.24	T	T	T
Jul	0.26	1.62	0.94	T	T	T
Aug	0.40	2.37	1.61	0.0	0.0	0.0
Sep	0.58	2.54	1.74	0.0	0.0	0.0
Oct	0.75	2.25	0.76	0.1	2.7	1.7
Nov	1.29	2.44	0.88	1.9	8.8	6.5
Dec	1.34	4.23	1.16	5.8	26.2	6.7
Average Year	11.71			21.5		

TWIN FALLS AREA

	Water Equivalent, inches			Snowfall, inches		
	Monthly Average	Max Month	24 Hr Record	Monthly Average	Max Month	24 Hr Record
Jan	1.14	3.22	0.85	5.7	17.1	8.0
Feb	0.73	1.86	0.75	2.8	15.0	5.0
Mar	0.79	1.59	1.27	2.3	12.5	9.0
Apr	0.84	2.35	1.05	0.8	4.5	2.0
May	1.06	2.92	1.42	0.5	5.0	2.0
Jun	0.96	2.82	0.88	0.0	0.0	0.0
Jul	0.21	0.56	0.54	0.0	0.0	0.0
Aug	0.35	2.77	0.87	0.0	0.0	0.0
Sep	0.47	2.33	0.65	0.0	0.0	0.0
Oct	0.62	2.46	0.98	0.3	3.0	1.0
Nov	0.98	2.27	0.78	1.3	7.0	3.0
Dec	1.14	3.89	1.21	4.9	16.0	9.0
Average Year	9.29			18.6		

POCATELLO AREA

	Water Equivalent, inches			Snowfall, inches		
	Monthly Average	Max Month	24 Hr Record	Monthly Average	Max Month	24 Hr Record
Jan	1.13	3.24	0.97	10.2	28.1	10.1
Feb	0.86	1.51	0.67	5.7	16.3	6.1
Mar	0.94	2.95	0.90	5.8	15.4	7.3
Apr	1.16	3.30	1.25	4.4	15.5	10.0
May	1.20	3.29	1.67	0.5	5.5	5.2
Jun	1.06	3.30	1.08	T	0.2	0.2
Jul	0.47	1.84	0.98	0.0	0.0	0.0
Aug	0.60	3.98	1.16	0.0	0.0	0.0
Sep	0.65	3.43	1.13	0.1	2.0	2.0
Oct	0.92	2.56	1.82	1.9	12.6	8.0
Nov	0.91	2.84	0.85	4.3	11.5	6.8
Dec	0.96	3.39	0.94	8.9	33.7	9.5
Average Year	10.86			41.8		

T = Trace

SOURCE: NOAA 1983a, b, and 1976

Table 3-3. Climatological Data Comparisons

	Temperature Data Averages, °F						# Days		
	Boise	Twin Falls	Pocatello	Boise	Twin Falls	Pocatello	Boise	Twin Falls	Pocatello
	Monthly	Monthly	Monthly	Daily Min	Daily Min	Daily Min	Min Temp 32° and Below	Min Temp 32° and Below	Min Temp 32° and Below
Jan	29.9	29.4	23.8	22.6	20.6	15.1	26	27	27
Feb	36.1	34.4	29.5	27.9	24.6	20.4	21	24	25
Mar	41.4	39.3	35.5	30.9	27.4	25.2	18	24	26
Apr	48.6	47.6	44.6	36.4	34.0	32.3	8	13	17
May	57.4	57.0	54.0	44.0	42.4	40.3	2	2	5
June	65.8	64.5	62.5	51.8	49.1	47.3	0	0	*
July	74.6	72.7	71.2	58.5	55.0	53.8	0	0	0
Aug	72.0	70.4	68.9	56.7	52.7	51.7	0	0	*
Sept	63.2	60.5	59.2	48.7	43.4	42.7	*	2	3
Oct	51.9	50.0	48.1	39.1	34.6	33.3	5	12	15
Nov	39.7	38.8	35.2	30.5	27.7	24.8	18	22	23
Dec	32.0	30.8	26.6	24.6	22.0	17.9	25	28	27
Year							123	154	169

	Precipitation Data Water Equivalent (inches)			Snowfall (inches)		
	Boise Monthly Average	Twin Falls Monthly Average	Pocatello Monthly Average	Boise Monthly Average	Twin Falls Monthly Average	Pocatello Monthly Average
Jan	1.64	1.14	1.13	7.3	5.7	10.2
Feb	1.07	0.73	0.86	3.7	2.8	5.7
Mar	1.03	0.79	0.94	1.9	2.3	5.8
Apr	1.19	0.84	1.16	0.7	0.8	4.4
May	1.21	1.06	1.20	0.1	0.5	0.5
June	0.95	0.96	1.06	T	0.0	T
July	0.26	0.21	0.47	T	0.0	0.0
Aug	0.40	0.35	0.60	0.0	0.0	0.0
Sept	0.58	0.47	0.65	0.0	0.0	0.1
Oct	0.75	0.62	0.92	0.1	0.3	1.9
Nov	1.29	0.98	0.91	1.9	1.3	4.3
Dec	1.34	1.14	0.96	5.8	4.9	8.9
Year	11.71	9.29	10.86	21.5	18.6	41.8

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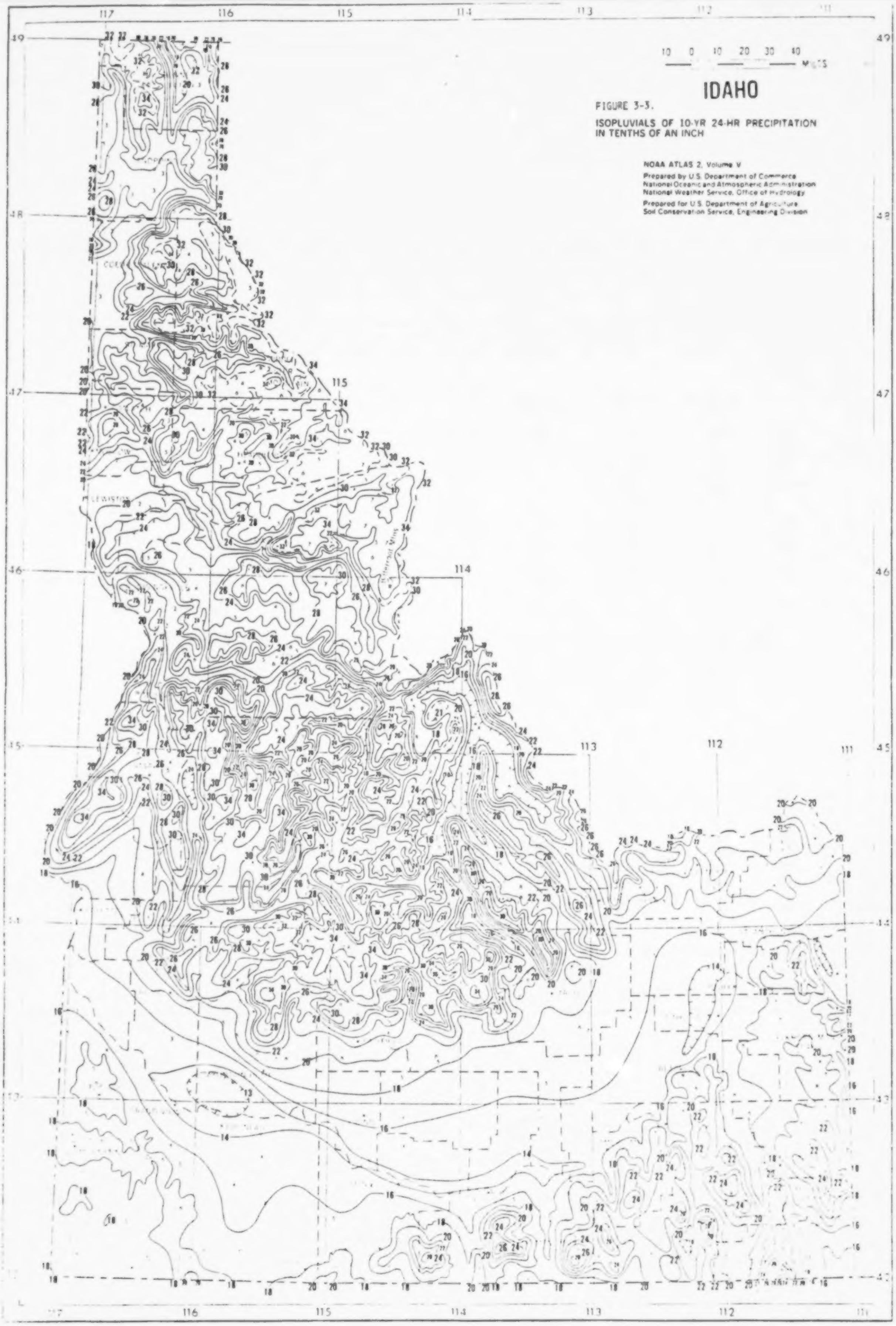
* Less than one-half

T Trace

SOURCE: NOAA 1983a, b, and 1976


10 0 10 20 30 40 MILES
117
116
115
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45
LEWISTON

IDAHO

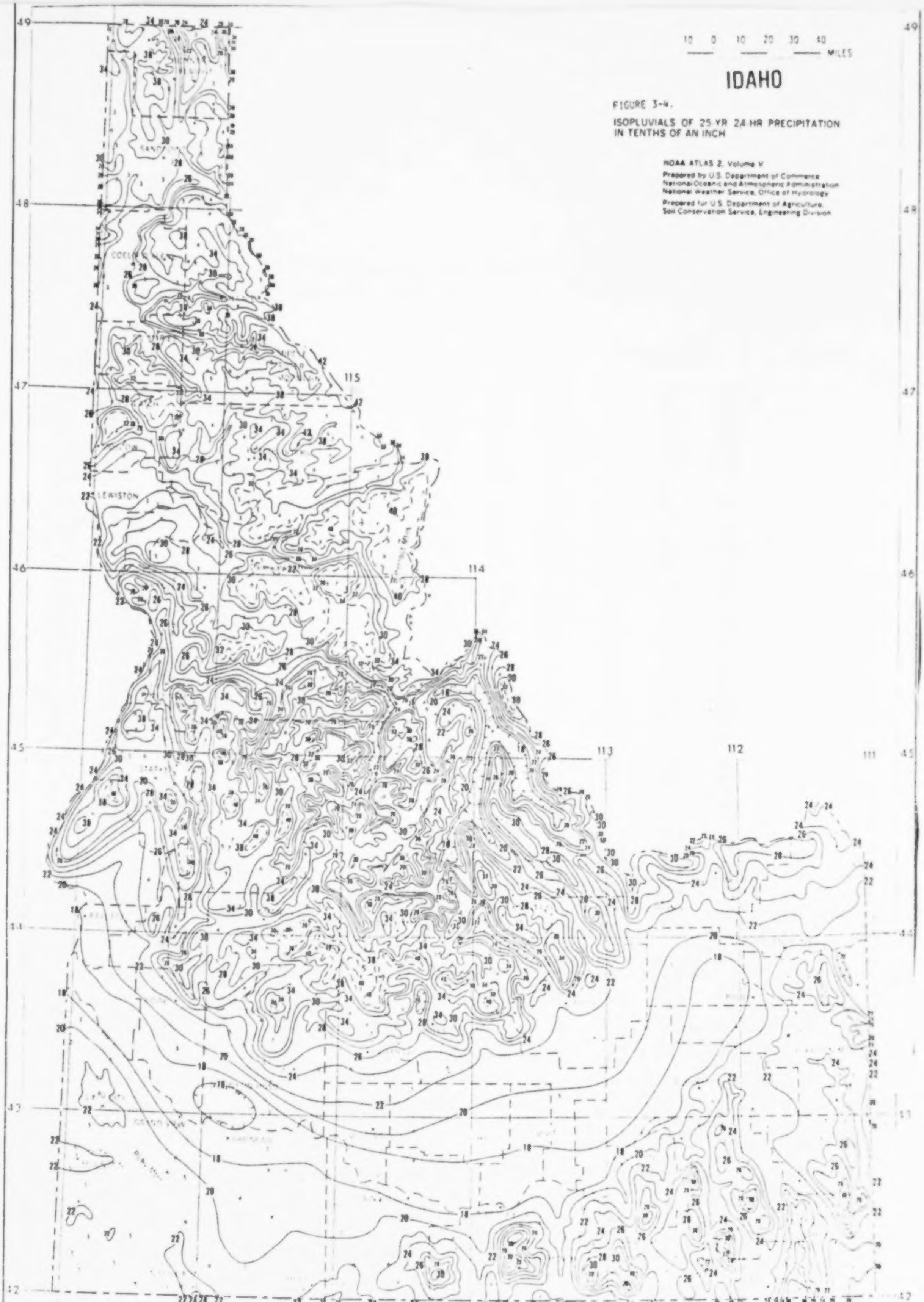
FIGURE 3-3.

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume V

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture
Soil Conservation Service, Engineering Division


10 0 10 20 30 40 MILES
49
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SANDPOINT
COEUR D'ALENE
LEWISTON
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34
38
42

IDAHO

FIGURE 3-4.

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume V

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Table 3-4. Cumulative 3- and 4-Month Precipitation at Boise, Idaho (1944-1983)

	3-Month Totals						4-Month Totals				
	Oct-Dec	Nov-Jan	Dec-Feb	Jan-Mar	Feb-Apr	Mar-May	Oct-Jan	Nov-Feb	Dec-Mar	Jan-Apr	Feb-May
1944	3.12										
1945	4.37	3.78	4.35	5.02	4.40	4.44	4.21	5.95	6.11	5.49	6.61
1946	4.02	5.12	4.92	4.35	3.33	2.57	5.74	6.43	6.59	4.70	3.88
1947	4.11	3.41	1.80	2.78	2.80	3.38	4.52	3.85	3.64	3.30	3.82
1948	3.81	2.74	3.05	3.81	4.37	3.70	4.92	4.32	4.47	5.18	5.28
1949	3.28	3.25	4.28	2.65	2.62	1.30	3.93	5.30	4.76	2.74	3.35
1950	4.14	4.61	4.30	5.63	3.65	3.83	5.81	5.70	6.31	6.18	4.92
1951	5.87	5.38	6.01	4.87	4.15	2.93	5.80	7.54	7.06	5.81	5.09
1952	1.35	5.51	4.83	4.41	4.25	4.21	7.11	6.63	6.88	5.49	5.33
1953	2.57	4.70	5.84	5.76	3.93	5.03	4.70	6.19	6.76	7.28	6.52
1954	2.47	3.55	2.79	2.84	2.17	2.57	3.66	4.10	3.99	3.26	3.12
1955	4.39	3.35	2.84	2.14	3.86	4.91	3.79	3.78	3.23	5.18	5.34
1956	3.50	5.82	5.30	3.47	2.92	4.19	6.56	6.73	5.69	5.09	5.10
1957	3.31	2.29	3.60	5.03	5.14	6.21	4.54	4.01	5.87	6.18	7.93
1958	2.41	4.26	5.36	3.85	4.42	4.56	4.68	6.17	5.93	5.79	6.47
1959	1.65	3.65	3.24	3.04	1.90	2.95	3.74	4.28	4.32	3.23	3.58
1960	2.74	2.22	3.60	4.46	3.56	3.03	2.98	3.96	4.99	4.89	4.77
1961	3.61	2.67	2.05	3.01	2.81	2.15	3.16	3.87	3.44	3.23	3.35
1962	3.14	2.85	2.67	3.04	2.96	5.09	4.61	3.62	3.94	3.96	5.86
1963	4.42	3.05	3.08	3.04	3.56	2.71	4.27	4.75	3.29	4.69	4.41
1964	5.73	5.89	3.67	3.29	2.18	3.75	6.88	6.08	4.31	4.64	3.94
1965	2.40	8.41	6.39	3.63	3.55	4.04	8.62	8.72	6.82	6.44	4.35
1966	3.30	2.93	2.15	2.14	1.94	1.53	3.21	3.66	2.75	2.75	2.26
1967	1.81	4.50	3.25	2.21	2.19	2.33	4.79	4.85	3.62	3.68	2.68
1968	4.15	1.82	2.79	3.00	2.92	1.46	2.24	3.68	3.50	3.35	3.32
1969	3.00	6.95	6.45	4.76	2.61	2.11	7.65	7.95	6.71	6.11	3.11
1970	4.21	6.23	5.94	5.21	2.27	2.70	6.87	6.53	6.98	6.14	3.00
1971	4.48	5.44	4.06	4.19	2.55	2.15	6.25	6.09	5.56	4.59	2.80
1972	3.54	6.10	4.69	4.56	3.03	2.44	6.63	7.01	6.19	5.18	3.35
1973	5.82	4.04	3.35	2.21	2.56	2.86	4.68	4.46	4.00	3.70	3.30
1974	3.83	6.02	4.24	3.51	2.83	2.27	7.17	6.68	5.74	4.18	2.93
1975	4.06	2.97	4.92	5.13	6.07	4.33	4.42	5.59	6.84	6.66	6.95
1976	0.75	3.56	4.09	3.52	3.63	2.78	5.55	4.87	4.81	5.12	4.09
1977	4.53	0.88	1.31	2.08	1.62	2.85	1.40	1.45	2.17	2.27	3.42
1978	1.66	6.69	6.33	5.30	5.27	4.13	6.90	8.19	7.76	7.64	5.63
1979	3.54	3.59	3.73	3.61	3.28	3.36	3.59	4.79	4.21	5.21	4.56
1980	3.05	3.60	3.59	4.99	4.63	7.11	5.10	4.89	5.73	6.19	8.40
1981	5.93	3.95	3.71	4.98	5.71	5.64	4.25	4.97	6.47	6.91	6.66
1982	4.76	6.38	5.68	4.35	3.72	2.57	7.35	7.92	7.07	5.14	4.11
1983	6.66	4.69	4.85	5.63	6.25	6.92	6.43	5.95	7.55	7.92	8.18

	3-Month Totals						4-Month Totals				
	Oct-Dec	Nov-Jan	Dec-Feb	Jan-Mar	Feb-Apr	Mar-May	Oct-Jan	Nov-Feb	Dec-Mar	Jan-Apr	Feb-May
Number:	40	39	39	39	39	39	39	39	39	39	39
Average:	3.64	4.28	4.08	3.88	3.48	3.52	5.10	5.42	5.28	5.01	4.66
Min:	0.75	0.88	1.31	2.08	1.62	1.30	1.40	1.45	2.17	2.27	2.26
Max:	6.66	8.41	6.45	5.76	6.25	7.11	8.62	8.72	7.76	7.92	8.40
Std Dev:	1.30	1.59	1.32	1.09	1.15	1.40	1.59	1.54	1.48	1.40	1.59
Var:	1.68	2.52	1.74	1.20	1.31	1.96	2.52	2.36	2.18	1.95	2.53